SELECTED

SWATERRESOURCES ABSTRACTS



VOLUME 23, NUMBER 8 AUGUST 1990

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey U.S. Department of the Interior

VOLUME 23, NUMBER 8 AUGUST 1990

W90-06555 -- W90-07506



As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

elected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the Water Resources Thesaurus. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE WATER RESOURCES SCIENTIFIC INFOR-MATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific Information Center U.S. Geological Survey MS 425 National Center Reston, VA 22092

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

SUPERCOMPUTER SIMULATION OF LIQUID DROP FORMATION, FALL, AND COLLISION. Texas Univ. at Arlington. Dept. of Mathematics. D. Greenspan.

Texas Univ. as Analysis of the Control of the Contr

Descriptors: *Computer models, *Fluid drops, *Hydrodynamics, *Model studies, *Simulation, *Supercomputers, Computers, Fluid mechanics, Mathematical studies, Physical properties.

On the basis of a molecular-type approach developed previously, a new generic liquid drop model is derived to simulate formation, fall, and collision processes. Drop generation is considered for an open basin in the upper half of an xy plane that lies above the x axis, onto which 2,500 particles are placed. A velocity is prescribed for each particle in an arbitrary fashion. All particles are allowed to interact dynamically, each, being acted upon by gravity and, locally only, by a Lennard-Jones type force. The distance of local interaction and gravity are denoted. To keep the fluid within the basin, particles are reflected symmetrically from the boundaries but with a constant velocity damping factor. Then, in accordance with the Newtonian dynamical equations, the particles are allowed to interact with the parameter choices. For drop fall simulation, the lowest particle in each strip was damped every 500 steps by having its vertical component of velocity multiplied by a constant factor. To study drop collision, the relatively circular drop configuration on the bottom of the leftmost column was isolated, and a symmetric image, with the same particle velocities, was generated about the y axis. For quantitative results for particular fluids whose Lennard-Jones parameters are known, one can proceed in any of three ways: first, one can use the formulas presented to direct molecular dynamical simulation. Second, one can use a least squares approximation. Finally, one can use a least squares approximation for the known force and then proceed numerically. In all cases, supercomputer capability seems essential. (Friedmann-PTT)

2. WATER CYCLE

2A. General

FACTORS CONTROLLING THROUGHFALL CHEMISTRY IN A BALSAM FIR CANOPY: A MODELING APPROACH. New York Botanical Garden, Bronx, NY. Inst. of

Ecosystem Studies.
For primary bibliographic entry see Field 2K.
W90-06556

RENEWAL THEORY CRITERIA OF EVALUATION OF WATER-RESOURCE SYSTEMS: RELIABILITY AND RESILIENCE.

Polish Academy of Sciences, Warsaw. Inst. of Geophysics. For primary bibliographic entry see Field 6B. W90-06811

MODELING RAINFALL-RUNOFF PROCESS INCLUDING LOSSES.

Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2E.
W90-06823

TRENDS IN FRESHWATER INFLOW TO SAN FRANCISCO BAY FROM THE SACRAMENTO-SAN JOAQUIN DELTA.

Consulting Engineer, 2530 Etna Street, Berkeley, California 94704.
For primary bibliographic entry see Field 2E.
W90-06827

DEVELOPMENT AND TESTING OF A SNOW-MELT-RUNOFF FORECASTING TECHNIQUE, Agricultural Research Service, Beltsville, MD. Hydrology Lab.

Hydrology Lab. A. Rango, and V. van Katwijk. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 135-144, February 1990. 11 fig, 2 tab, 7 ref.

Descriptors: *Hydrologic models, *Model studies, *Runoff forecasting, *Snowmelt, *Snowmelt-runoff models, *Streamflow forecasting, Hydrographs, Simulation analysis.

The snowmelt-runoff model (SRM) was used to produce accurate simulations of streamflow during the snowmelt period (April-September) for ten years on the Rio Grande Basin (3419 sq km) near Del Norte, Colorado, U.S.A. In order to use SRM in the forecast situation, it was necessary to develop a family of snow cover depletion curves for each elevation zone based on accumulated snow water equivalent on April 1. Selection of an appropriate curve for a particular year from snow course measurements allows input of the daily snow cover extent to SRM for forecast purposes. Data from three years (1980, 1981, and 1985) were used as a quasiforecast test of the procedure. In these years forecasted snow cover extent data were input to SRM, but observed temperature and precipitation data were used. The resulting six-month hydrographs were very similar to the hydrographs in the ten simulation years previously tested based on comparisons of performance evaluation criteria. Based on this result, the Soil Conservation Service (SCS) requested SRM forecasts for 1987 on the Rio Grande. Using the same procedure but with SCS estimated temperature and precipitation data, SRM produced a forecast hydrograph that had a R squared = 0.82 and difference in seasonal volume of 4.4 percent. To approximate actual operational conditions, SRM computed daily flows were updated every seven days with measured flows. The resulting forecast hydrograph had a R squared = 0.90 and a difference in volume of 3.5 percent. The method developed needs to be refined and tested on additional years and basins, but the approach appears to be applicable to operational runoff forecasting using remote sensing data. (Author's abstract)

GLOBAL WATER CYCLE: GEOCHEMISTRY AND ENVIRONMENT.

Yale Univ., New Haven, CT.
E. K. Berner, and R. A. Berner.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
1987, 1979.

Descriptors: *Acid rain, *Environmental quality, *Geochemistry, *Geohydrology, *Hydrologic cycle, *Natural waters, *Water chemistry, Estuaries, Groundwater, Lakes, Marine environment, Rainfall, Rivers, Soil water.

The study of natural waters is approached via a discussion of the geological, biological, physical, and anthropogenic factors which control the chemical composition of rainwater, groundwater, rivers, lakes, estuaries, and the oceans. The approach is worldwide in scope and includes quantitative estimates of the relative importance of various natural and human processes on water composition and cycling of the major elements. Chapter contents include: the structure and physical and chemical properties of water; oceanic and atmospheric circulation and the greenhouse effect; rain formation, aerosols, gases and rain, sulfate and nitrogen in rain, and acid rain; biogeochemical cycling in forests, and chemical weathering; suspended matter, chemical composition, and pollution; physical and biological processes of lakes, pollutant changes, acid lakes, and saline lakes; estuaries and hypersaline basins; and chemical composition, energy sources, major processes of seawater modification, and chemical budgets for individuals elements, within the ocean. (Lantz-PTT)

W90-06946

HYDROLOGIC EFFECTS OF CLIMATE CHANGE IN THE DELAWARE RIVER BASIN. Geological Survey, West Trenton, NJ.

Geological Survey, West Trenton, NJ. G. J. McCabe, and M. A. Ayers. Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1231-1242, December 1989. 11 fig, 3 tab, 39 ref.

Descriptors: *Climatic changes, *Delaware River Basin, *Environmental effects, *Global warming, *Hydrologic budget, Evapotranspiration, Humid climates, Hydrologic models, Precipitation, Runoff, Snow, Soil water, Temperate zone, Water supply.

The Thornthwaite water balance and combination of temperature and precipitation changes representing climate change were used to estimate changes in seasonal soil-moisture and runoff in the Delaware River basin. Winter warming may cause a greater proportion of precipitation in the northern part of the basin to fall as rain, which may increase winter runoff and decrease spring and summer runoff. Estimates of total annual runoff indicate that a 5% increase in precipitation would be needed to counteract runoff decreases resulting from a warming of 25 C; a 15% increase for a warming of resulting the precipitation increases, may cause a 9-25% decrease in runoff. The general circulation model derived changes in annual runoff ranged from -39 to +9%. Results generally agree with those obtained in studies elsewhere. The changes in runoff agree in direction but differ in magnitude. In this humid temperate climate, where precipitation is evenly distributed over the year, decreases in snow accumulation in the northern part of the basin and increases in evapotranspiration throughout the basin could change the timing of runoff and significantly reduce total annual water availability ungest precipitation were to increase concurrently. (Author's abstract)

2B. Precipitation

ACID DEPOSITION, SUMMER DROUGHT AND ENHANCED PRODUCTION OF NITRATE IN FOREST SOILS; RISK COFACTORS RELATIVE TO FOREST DECLINE. AN ADDITIONAL HYPOTHESIS CONCERNING THE SYNERGISTICAL EFFECTS: THE NITROUS ACID CYCLE.

Association pour la Prevention de la Pollution Atmospherique, Bordeaux (France). J.-A. Bardy.

Environmental Technology Letters ETLEDB, Vol. 10, No. 7, p 681-686, July 1989. 68 ref.

Descriptors: *Acid rain, *Ecological effects, *Forest ecosystems, *Forest soils, *Nitrates, *Synergistic effects, Acidification, Ammonia, Drought, Nitrification.

A correlation seems to exist between forest decline and enhanced production of nitrate in forest soils. Nitrate in streamwaters may provide an early warning of incipient forest damage. Dry and warm summers are more injurious because acidification pushes give higher aluminum ion concentrations in the direct vicinity of the roots. The purpose of this paper is to review previous studies and to suggest a link between acid precipitation containing ammonium ions, acidification pushes, nitrate production, and forest decline. The author suggests that drought conditions may trigger forest decline in areas subjected to acid precipitation. Soil drying produces a pulse of decomposition of organic matter, favored by aluminum ion levels, thereby increasing the amount of carbon and nitrogen available for subsequent nitrification. The first rainfall after a summer drought induces a surge of activity of autotrophic nitrifying microorganisms. During acidification pulses, an oxygen stress resulting from rapid oxygen consumption in nitrification could induce a temporal shift of ammonium ion and nitrite oxidation giving, within a few days, a

Field 2—WATER CYCLE

Group 2B-Precipitation

transient peak of nitric acid accumulation injurious to fine roots and mycorrhizae. (Brunone-PTT)

OBJECTIVE ANALYSIS OF DAILY RAINFALL BY DISTANCE WEIGHTING SCHEMES ON A MESOSCALE GRID.

Atmospheric Environment Service, Downsview

N. Bussieres, and W. Hogg. Atmosphere-Ocean ATOCDA, Vol. 27, No. 3, p 521-541, September 1989. 8 fig, 5 tab, 14 ref.

Descriptors: *Climatology, *Error analysis, *Precipitation napping, *Rainfall, *Rainfall distribution, *Statistical analysis, Climatic data, Comparison studies, Interpolation, Performance evaluation, Sampling, Spatial distribution, Statistical methods.

The error of spatial interpolation was studied in the context of a climatic data gridding project (CLI-GRID). Four objective analysis (OA) tech-(CLI-GRID). Four objective analysis (OA) techniques were implemented: the empirical techniques of Barnes, Cressman and Shepard, and a Gandin-based statistical technique. These were applied to the interpolation of irregularly distributed daily rainfall data. Spatial resolution of the interpolated arrays was 0.05 degree of latitude by 0.05 degree of longitude. In this experiment, radar rainfall patterns reserved as referenced to the formulations of terns served as reference data for evaluations of OA techniques. Each reference pattern was sampled at the irregularly spaced locations of a climatic rain-gauge network. The sampled data were then input to one of the four OA techniques. The resulting analysis was subtracted from the corresponding reference pattern. Absolute values of the differences were recorded. This sampling-to-difference cycle was repeated with 63 reference patence cycle was repeated with 63 reference pat-terns. Every map of absolute differences was summed. The resulting map of total errors was normalized by the sum of the reference patterns. Average bias, average RMS error and averages of the ratios of the standard deviations were slated computed. All four OA techniques were evaluated separately. The authors recognized that totally unbiased intercomparisons were not possible because of the range in execution parameters for each OA technique. Reasonable efforts were made to minimize subjectivity in the setting of parameters. For application to the specific project grid, the statistical optimal interpolation technique displayed the lowest RMS errors. This technique and Shepard OA, were found more suitable than the other two niques studied. Statistical and Barnes OA displayed zero average bias and would be useful for areal average computations. The Cressman OA was judged least suitable for interpolation of daily rainfall. An application of the two-dimensional error maps to network analysis was demonstrated by plotting the relationship between interpolation errors and distance (D) from the closest station. Error increased as D to the 1/2. Error and station density were verified as being inversely related.
(Author's abstract)
W90-06655

POLARIZATION RADAR ESTIMATES OF RAINDROP SIZE SPECTRA AND RAINFALL

RATES.
University of Manchester Inst. of Science and Applied Technology (England). Dept. of Pure and Applied

rnysics.

A. J. Illingworth, and I. J. Caylor.

Journal of Atmospheric and Oceanic Technology

JAOTES, Vol. 6, No. 6, p 939-949, December

1989, 10 fig. 4 tab, 31 ref.

Descriptors: *Drop size, *Instrumentation, *Mete-orology, *Polarization radar, *Radar, *Remote sensing, Estimating, Fluid drops, Frequency distri-bution, Measuring instruments, Polarization, Rain, Rainfall, Rainfall rate, Reflectance techniques.

The differential reflectivity (Z sub DR) measures the mean shape of hydrometeors and provides and estimate of the mean size of raindrops. Observations of Z sub DR for rain may be combined with the conventional radar reflectivity factor (Z) and fitted to any two-parameter raindrop size distribu-tion and this information used to derive more accurate rainfall rates. In such work the precise

shape of raindrops is a critical parameter. Recently available data suggest that large raindrops are available data suggest that large raindrops are more oblate than previously believed. These new shapes support the idea that Z sub DR values above 3.5 dB can be attributed to rain. Average values of Z sub DR as a function of Z obtained in heavy rain by the Chilbolton radar agree very closely with those predicted using the new shapes. Statistics are also presented of the natural variability of raindrop spectra in heavy rain. Analytic expressions are proposed for computing rainfall rate from Z and Z sub DR. (Author's abstract) W90-06665

FORMALISM FOR COMPARING RAIN ESTI-MATION DESIGNS

Texas A and M Univ., College Station. Coll. of Geosciences. For primary bibliographic entry see Field 7C. W90-06666

COMPARISON OF SEVERAL RADIOMETRIC METHODS OF DEDUCING PATH-INTEGRAT-ED CLOUD LIQUID WATER. McGill Univ., Montreal (Quebec). Dept. of Mete-

orology.

C. Wei, H. G. Leighton, and R. R. Rogers.

Journal of Atmospheric and Oceanic Technology

JAOTES, Vol. 6, No. 6, p 1001-1012, December

1989. 7 fig, 6 tab, 19 ref.

Descriptors: *Cloud liquid water, *Clouds, *Data interpretation, *Meteorology, *Radiometry, Mathematical analysis, Simulation, Statistical methods, Water.

Using radiometer data collected during the Canadian Atlantic Storms Program, we have investigated five different methods of estimating the pathintegrated, or columnar, cloud liquid water. The methods consist of one-and two-channel physical retrievals, the standard method of linear statistical investigation with the description. inversion using two channels, and two statistical methods that proceed from an initial determination methods that proceed from an initial determination of several empirical regressions between measured and computed quantities. Though differing in details and complexity, the methods gave estimates of cloud liquid that did not deviate greatly from one another. We assessed the accuracy of the methods by simulation. Using hypothetical profiles of cloud liquid in archival soundings, we calculated the atmospheric emission and thus the brightness temamospheric emission and trus the originness tem-peratures that would be measured in the two chan-nels of the radiometer. These values were taken as data for the five methods, and the amount of liquid was calculated. Results showed that the three stawas calculated. Results smowed that the three sta-tistical methods were more accurate than the phys-ical methods, but no one of the three was signifi-cantly better than the others. In the four methods requiring measurements in two channels, the corequiring measurements in two channels, the co-lumnar water vapor is computed as part of the retrieval procedure. A comparison of the comput-ed with the actual vapor amounts showed that one of the statistical methods employing empirical re-gressions was the most accurate for vapor retriev-al. For this optimum method, the rms deviation of the measured columnar liquid from its actual value was 0.159 millimeters and the rms deviation of the columnar vapor was 0.867 millimeters. As fractions of the overall average liquid and vapor in the simulations, these deviations amount to 37% and 8.7% respectively. If cases are excluded in which the liquid amount is small or nonexistent, the frac-tional deviation of the liquid estimates decreases and that of the vapor increases. (Author's abstract) W90-06667

FIELD AND LABORATORY COMPARISONS OF TWO CLOUD CONDENSATION NUCLEI

Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Atmos-

Depheric Physics.

E. K. Bigg, A. D. Kaye, and W. J. Megaw.

Journal of Atmospheric and Oceanic Technology

JAOTES, Vol. 6, No. 6, p 1066-1077, December

1989. 13 fig, 14 ref.

Descriptors: *Clouds, *Condensation, *Instrumentation, *Measuring instruments, *Meteorology,

*Nucleation, Atmosphere, Field tests, Laboratory methods, Supersaturation.

Cloud microstructure is controlled to a considerable extent by the subcloud supersaturation spec-trum of cloud condensation nuclei (CCN) and by the updraft speed, and it is therefore to be able to ure the concentrations of CCN active at various supersaturations. An extensive series of experiments was carried out to compare the performance of two cloud nucleus counters, a Static Diffusion Chamber and a Thermal Diffusion Tube, operating under quite different principles, in a wide range of under quite different principles, in a wide range of field conditions and with a number of laboratory aerosols. The operating ranges of the instruments only overlap slightly; nevertheless the supersaturation versus CCN concentration spectra obtained showed rather good agreement at the range boundaries. Neither instrument performed reliably outside its accepted range, but together they provided reliable data over the supersaturation range from 0.04 to 1.25 percent and suggest that use of the two instruments in combination would provide a construments. instruments in combination would provide a con-venient and reliable method of obtaining CCN concentrations over this range. (Author's abstract) W90-06668

REMOTE SENSING OF CLOUDS AND FOG WITH A 1.4-MM RADAR. Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering. J. B. Mead, R. E. McIntosh, D. Vandemark, and

C. T. Swift.

JAOTES, Vol. 6, No. 6, p 1090-1097, December 1989. 9 fig, 2 tab, 11 ref.

Descriptors: *Clouds, *Fog, *Instrumentation, *Measuring instruments, *Meteorology, *Remote sensing, Atmosphere, Oscillatory waves, Radar, Reflectance techniques.

A recently developed 1.4 millimeter wavelength incoherent radar has potential for remote sensing of low reflectivity atmospheric targets for ranges up to several kilmoeters. Power output of 60 watts is achieved using an Extended Interaction Oscillator (EIO). Preliminary reflectivity measurements of clouds and fog for ranges between 36 and 1900 meters are believed to be the first such measurements at this wavelength. Limitations on the accuracy of the reflectivity measurements are disracy of the reflectivity measurements are cussed, highlighting uncertainties due to highly variable attenuation. (Author's abstract) W90-06669

RADIATIVE TRANSFER TO SPACE THROUGH A PRECIPITATING CLOUD AT MULTIPLE MICROWAVE FREQUENCIES. PART III, INFLUENCE OF LARGE ICE PARTI-

Florida State Univ., Tallahassee. Dept. of Meteorology. For primary bibliographic entry see Field 7B. W90-06724

STRUCTURE OF A LAND BREEZE AND SNOWFALL ENHANCEMENT AT THE LEADING EDGE.

Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

Temperature Science.
K. Tsuboki, Y. Fujiyoshi, and G. Wakahama.
Journal of the Meteorological Society of Japan
JMSJAU, Vol. 67, No. 5, p 757-770, October 1989.
19 fig. 1 tab, 21 ref, append.

Descriptors: *Land breezes, *Snow, *Wind, Ishi-kari Plain, Japan, Precipitation, Radar, Storms, Weather.

A land breeze is frequently observed along the coastal region of the Ishikari Plain during the winter season. A land breeze front is formed offwinter season. A land preeze front is formed off-shore between colder over-land air and warmer over-sea air. A single Doppler radar was used to examine the structure of the land breeze and its effect on snow clouds. The vertical profile of wind velocity was divided into three layers: the land breeze layer (about 300 m in depth), the shear layer

Precipitation—Group 2B

and the prevailing wind layer. The frontal surface was steep near the front, but almost horizontal at a distance from the front. Kelvin-Helmholtz instability waves were observed along the interface of the land breeze and the northwesterly monsoon wind. land breeze and the northwesterly monsoon wind. The land breeze strongly influenced the modification of snow clouds. A rapid intensification of snow cloud echo, which was often observed at the and beeze front, might have been caused by a strong low-level convergence at the front. Behind the front, however, the echo rapidly weakened and dissipated, since the air mass of the north-westerly monsoon wind lost vapor and its lower portion became stable when mixed with the land breeze. became stable when mixed with the land breeze. Consequently, convection was suppressed. Since the intensification and dissipation of echo recurred, the intense echo region seemed to be stagnant at the front, while each cell moved at the speed of the prevailing wind; this resulted in the localization of heavy precipitation at the front. The time-averaged distribution of echo intensity shows the concentration of precipitation in the coastal region where the front was located. Analysis of the AMeDAS (Automated Meteorological Data Acquisition System) data also shows that precipitation was localized along the coastal region when there was a land breeze. (Author's abstract) W90-06725

NOTES AND CORRESPONDENCE, DEPEND-ENCE OF RAINFALL VARIABILITY ON MEAN RAINFALL, LATITUDE, AND THE SOUTHERN OSCILLATION.

Bureau of Meteorology, Melbourne (Australia). Research Centre

Research Centre.
N. Nicholls, and K. K. Wong.
Journal of Climate JLCLEL, Vol. 3, No. 1, p 163170, January 1990. 5 fig, 3 tab, 5 ref.

Descriptors: *Rainfall, *Southern oscillation, Annual variation, Latitude, Rainfall index.

The relationship between the relative variability of annual rainfall, the long-term mean annual rainfall, the latitude, and the correlation between annual rainfall and the Southern Oscillation Index was examined, using data from 974 stations. A nonlinear relationship between these variables accounts for 94% of the variance in annual rainfall variabili-ty. Relative variability typically increases as mean annual rainfall decreases, as latitude decreases, and as the effect of the Southern Oscillation increases. There is an interaction between latitude and the I nere is an interaction between latitude and the Southern Oscillation so that the effect of the Southern Oscillation on variability weakens as latitude increases. (Author's abstract) W90-06798

GENERATION AND PROPAGATION OF A NOCTURNAL SQUALL LINE PART I: OBSERVATIONS AND IMPLICATIONS FOR MESOS-CALE PREDICTABILITY.

National Center for Atmospheric Research, Boulder, CO. R. E. Carbone, J. W. Conway, N. A. Crook, and

M. W. Moncrieff.

Monthly Weather Review MWREAB, Vol. 118,
No. 1, p 26-49, January 1990. 24 fig, 81 ref.

Descriptors: *Climatology, *Kansas, *Meteorology, *Squalls, *Storms, *Weather, Convective weather, Convergence, Forecasting, Horizontal vorticity, Mesoscale convective systems, Moisture.

The initiation and forcing of a squall line on 26-27 May 1985 near Wichita, Kansas is examined. The may 1985 hear wichtal, Annas is examined. The squall line is secondary convection in the sense that it is preceded in the diurnal cycle by other mesos-cale convective systems. The squall line develops in synoptic conditions frequently associated with convective weather in the central United States. This includes moderate shear, moderate-to-high convective available potential energy, a quasi-stationary dryline, a low-level southerly jet, and as kPa moist tongue. The initiation of free convection is specifically attributed to a gust front that propa-gates into a low-level jet with attendant horizontal vorticity, convergence and moisture. The gust front initially propagates as a gravity current and subsequently as an internal undular bore. Observa-tions of gravity currents, gravity waves and the

'collision' of radar echo 'boundaries' provide valucollision of radar ecno boundaries provide valu-able clues for short period forecasting. They estab-lish the presence of potential triggering mecha-nisms that can propagate from convectively less-favorable to more-favorable environments. Such nisms that can propagate from convectively less-favorable to more-favorable environments. Such observations in themselves, however, are insufficient to establish the dynamical causes of convection. To forecast squall line precipitation in metropolitan areas beyond one to four hours is a major challenge given the ubiquity of weakly coupled, shallow disturbances in the nocturnal PBL. While it is necessary to model and accurately forecast larger scale conditions, this is likely to be insufficient for advances in locationally specific 6-12 horecasts of convective precipitation. Finally, the squall line described herein forms in a region where there exists, climatologically, a nocturnal maximum in thunderstorm occurrence. If this event is typical, then it suggests that the nocturnal maximum is due, in part, to an interaction between earlier disturbances that have formed over the Rockies and unstable conditions in the vicinity of the Great Plains southerly jet. This may be viewed as a form of discrete propagation for mesoscale convective systems. (See also W90-06806) (Author's abstract)

GENERATION AND PROPAGATION OF A NOCTURNAL SQUALL LINE, PART II: NUMERICAL SIMULATIONS,

National Center for Atmospheric Research, Boulder, CO.

uer, co. N. A. Crook, R. E. Carbone, M. W. Moncrieff, and J. W. Comway.
Monthly Weather Review MWREAB, Vol. 118, No. 1, p 50-65, January 1990. 18 fig, 28 ref.

Descriptors: "Climatology, "Kansas, "Meteorology, "Model studies, "Squalls, "Storms, "Weather, Convection, Convective regeneration, Gust front, Low-level moisture, Low-level shear, Mesoscale oscillation, Numerical models.

The mechanisms behind the convective regenera-tion that occurred at midnight on 26 May 1985 in the Kansas PRE-STORM network are examined with a numerical cloud model. Three mechanisms that could have caused the regeneration are identified: (1) an increase in low-level moisture, (2) an increase in low-level shear and (3) a mesoscale oscillation forced by previous convection. The first oscillation forced by previous convection. The first numerical experiments begin with a horizontally uniform environment. A primary squall line is generated in this environment and is then allowed to decay. Four hours after the decay, a second convective system develops at the leading edge of the gust front from the primary squall line. It is shown that this secondary generation is due to a mesoscale oscillation centered at 70 kPa that is forced by the previous convective system. Horizontal variance of the property of the previous convective system. Horizontal variance of the previous convective system. Horizontal variance of the previous convective system. the previous convective system. Horizontal variations in the upstream environment are then considered. An increase in low-level moisture is examsidered. An increase in low-level mosture is examined first, and it is shown that the consequent lowering of the level of free convection allows the gust front to trigger new convection. It is also found that the convective regeneration is stronger when the gust front collides with the moisture gradient during the upward phase of the mesoscale oscillation. Horizontal increases in low-level shear are then considered. In the region of enhanced shear, the lifting at the gust front is increased and consequently new convection can be triggered. In a comparison of the three regeneration mechanisms it is found that the strongest convection occurs for increases in low-level shear. (See also W90-06805) (Author's abstract)

ESTIMATION OF EXTREME PRECIPITA-TION IN NORWAY.

Norske Meteorologiske Inst., Oslo. E. J. Forland, and D. Kristoffersen. Nordic Hydrology NOHYBB, Vol. 20, No. 4/5, p 257-276, 1989. 6 fig, 5 tab, 14 ref.

Descriptors: *British growth-factor method, *Meteorology, *Norway, *Precipitation, *Probable maximum precipitation, Model studies, Rainfall

According to the World Meteorological Organiza-According to the World Meteorological Organization, different but equally valid approaches may yield slightly different estimates of probable maximum precipitation (PMP). For some basins in Norway the different methods yield more than 'slightly different' estimates. All existing methods for estimation of PMP are connected to rather large uncertainties, and the estimates must be considered as approximations. By using different methods it may be possible to assess the uncertainties in sidered as approximations. By using different methods it may be possible to assess the uncertainties in the PMP estimates. For Norwegian conditions a modified version of the British growth-factor method is preferred. Although the maximizing procedure differs from those usually accepted, the uncertainties in estimating PMP in Norway are so great that this method may be regarded as least as valid as any other. In addition it is quite easy to perform and may be used for both areas with representative rainfall stations and for areas without rainfall observations. In the last case the rather out rainfall observations. In the last case the rather well known average annual rainfall (AAR) pattern well known average annual rainfall (AAR) pattern is one of the input parameters. For areas with uncertain AAR values, average annual runoff may be used to assess the AAR value. These methods yield values for various return periods, various area sizes, various durations, specified seasons, and also ensures regional consistency as well as internal consistency between the regions and the PMP value. For critical hydrologic regulations, the PMP value should be estimated by more than one method, and preferably by both statistical and meteorological methods. (Author's abstract) W90-06814

MODELING RAINFALL-RUNOFF PROCESS INCLUDING LOSSES,

Academia Sinica, Beijing (China). Inst. of Geogra-For primary bibliographic entry see Field 2E. W90-06823

INFILTRATION EVALUATION OF FOUR ME-CHANICAL RAINFALL SIMULATION TECH-NIQUES IN SIERRA NEVADA WATERSHEDS. Nevada Univ., Reno. Dept. of Range, Wildlife and

For primary bibliographic entry see Field 7B. W90-06829

DEUTERIUM VARIATIONS IN STORM RAIN-FALL: IMPLICATIONS FOR STREAM HY-DROGRAPH SEPARATION.

Universities Space Research Association, Huntsville, AL. J. J. McDonnell, M. Bonell, M. K. Stewart, and A.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 455-458, March 1990. 2 fig, 4 tab, 24 ref.

Descriptors: *Deuterium, *Hydrograph analysis, *Hydrographs, *New Zealand, *Rainfall-runoff relationships, *Rainstorms, *Tracers, Hydrogen iso-

Isotopic variation in storm rainfall is an important consideration in hydrograph separation using the mass balance approach but is rarely considered when determining the accuracy of old water estimates. Study of a small watershed on the South Island of New Zealand in which new water is a major component of the storm hydrograph shows that, in addition to the within-storm isotopic variations themselves, rainfall weighting techniques may substantially influence estimates of old/new water as a function of both total runoff and total quick flow production. Two incremental approaches to rainfall weighting are presented. Results show that within-storm incremental weighting is better than the standard weighting technique, ing is better than the standard weighting technique, which imposes a total storm rainfall value exogenously on the mass balance equation. (Author's abstract) W90-06854

STOCHASTIC INTERPOLATION OF RAIN-FALL DATA FROM RAIN GAGES AND RADAR USING COKRIGING: 1. DESIGN OF EXPERIMENTS.

Group 2B-Precipitation

Utah Water Research Lab., Logan. D.-J. Seo, W. J. Krajewski, and D. S. Bowles. Water Resources Research WRERAQ, Vol. 26, No. 3, p 469-477, March 1990. 1 fig, 34 ref. NSF Grant No. ECE-8419189.

Descriptors: *Cokriging, *Data interpretation, *Kriging, *Radar, *Rain gages, *Rainfall, *Statistical methods, Comparison studies, Experimental

Cokriging is used to merge rain gage measure-ments and radar rainfall data. The cokriging estimators included are ordinary, universal, and disjunctive. To evaluate the estimators, two simulajunctive. To evaluate the estimators, two simula-tion experiments are performed. The first experi-ment assumes that high-quality radar rainfall fields are ground truth rainfall fields. From each ground truth rainfall field, multiple combinations of rain gage measurement field and radar rainfall field are artificially generated with varying gage network density and error characteristics of radar rainfall. The second experiment uses a stochastic space-time rainfall model to generate assumed ground truth rainfall fields of various characteristics. Due to the sparsity of rain gage measurements, the second-order statistics required for cokriging can only be estimated with large uncertainty. The ad-verse effects of this uncertainty, and the point verse effects of this uncertainty, and the point sampling error of rain gage measurements are ex-plicitly assessed by cokriging the ground truth rainfall data and the radar rainfall data with near perfectly known second-order statistics. (Author's abstract) W90-06856

BIOGEOCHEMICAL CYCLES IN FORESTS OF THE SIERRA DE BEJAR (SALAMANCA, SPAIN): RETURN OF BIOELEMENTS IN RAINFALL.

Instituto de Microbiologia Bioquimica, Salamanca (Spain). For primary bibliographic entry see Field 2K. W90406861

USE OF TIME SERIES ANALYSIS TO DETECT

CLIMATIC CHANGE.
National Hydrology Research Inst., Saskatoon (Saskatchewan). Hydrometeorological Research Div.

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 259-279, November 1989. 11 fig, 2 tab, 22 ref.

Descriptors: *Climatic changes, *Global warming, *Greenhouse effect, *North America, *Time series analysis, Alberta, Errors, Great Salt Lake, Lake Superior, Lake Victoria, Minnesota, Nova Scotia, Ontario, Regression analysis, Samples, Statistical analysis, Usenda, Utah analysis, Uganda, Utah.

Some climate-related time series were analyzed to see if the effects of any such change can be identified. Series of lake levels and river flows were analyzed for linear trends, periodicities, autoregressions, and random residuals. Time series used were: (1) river flows (1916-1986: Bow River, Alleys 1916-1986: Bow River, Alleys 1916were: (1) river flows (1916-1986: Bow River, Alberta; Saugeen River, Ontario; and St. Mary's River, Nova Scotia); (2) lake levels (1918-1987: Lake Superior at Duluth, Minnesota; Lake Victoria, Uganda; and Lake Superior, Michipicoten Harbour). Comparisons were made with precipitation at Banff, Alberta (1918-1986), and the maximum levels of Great Salt Lake, Utah (1851-1988). Possilevels of Great Salt Lake, Utah (1851-1988). Possi-ble physical causes are given for those components found to be significant. No statistical components were found that could be ascribed to 'greenhouse'-induced climatic change. Reasons for the lack of detectable change (besides its possible absence) include: limited sample size, insensitivity of data or errors, or inappropriate analysis techniques. (Roch-ester, PTT)

RAINFALL INTERCEPTION BY BRACKEN LITTER: RELATIONSHIP BETWEEN BIO-MASS, STORAGE, AND DRAINAGE RATE. King's Coll., London (England). Dept. of Geography. For primary bibliographic entry see Field 2I.

W90-06899

QUALITY ASSURANCE AUDITS OF THE EPA STATE-OPERATED PRECIPITATION COL-LECTION NETWORK: 1987. Research Triangle Inst., Research Triangle Park,

For primary bibliographic entry see Field 7B. W90-06949

THEORETICAL ANALYSIS AND METEORO-LOGICAL INTERPRETATION OF THE ROLE OF RAINDROP SHAPE ON MICROWAVE AT-TENUATION AND PROPAGATION PHASE SHIFTS: IMPLICATION FOR THE RADAR

MEASUREMENT OF RAIN.
Applied Research Corp., Landover, MD.
For primary bibliographic entry see Field 7B.
W90-06967

STEREORADAR METEOROLOGY: A PROM-ISING TECHNIQUE FOR OBSERVATION OF PRECIPITATION FROM A MOBILE PLAT-

Centre de Recherches en Physique de l'Environne ment, Issy-les-Moulineaux (France).

J. Testud, and P. Amayenc.

Journal of Atmospheric and Oceanic Technology
JAOTES, Vol. 6, No. 1, p 89-108, February 1989. 15 fig, 21 ref.

Descriptors: *Instrumentation, *Meteorological data collection, *Radar, *Rainfall distribution, *Rainfall rate, *Remote sensing, *Simulated rainfall, *Simulation analysis, Estimating, Mathematical models.

A new concept in the measurement of precipitation by radar is studied. The principle consists of stereoscopic observations: the same precipitation screenscopic observations: the same precipitation cell is observed by two radars operating at the same attenuated frequency but following two different angles of view. For instance, a system of two ground based 20 kilometer-spaced radars operating in X-band may provide stereoscopic observations. anng in X-band may provine stereoscopic observa-tions. The present paper considers more particular-ly an airborne radar configuration where a dual beam antenna system, combined with the aircraft displacement, views a precipitation cell under two incidents. In the method developed, the signal of interest is the difference z1-z2 between the apparent radar reflectivities (in dBZ) observed from the two viewing angles. A second-order differentiation of z1-z2 allows one to estimate the along track gradient in the attenuation coefficient. However, because this estimate is too noisy, a variational method is proposed to retrieve the K-field from the z1 and z2 observations. The validation of such a concept is then investigated on the basis of a numerical simulation. In consideration of a simple raincell model and realistic sampling of the apparent reflectivity fields z1 and z2, the K-field can be ent relieuvity neids 21 and 22, the K-neid can be reliably retrieved in the range of values 0.5 to 7 dB per Km. The obtained K-field may then be used to correct the apparent reflectivities for attenuation, and achieve an estimate of the 'true' reflectivity Z. Another variational approach draws benefit of the simultaneous knowledge of Z and K to achieve an improved estimate of the rainfall rate R. A numerical simulation is again used as a tool to test it. (Author's abstract)
W90-06968

MINISODAR MEASUREMENTS OF RAIN. Centre for Environmental Research, Biological, Environmental, and Medical Research Division, Argonne National Laboratory, Argonne Division, Argonne National Laboratory, Argonne Milinois. T. M. Weckwerth, T. J. Martin, and R. L. Coulter, Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 6, No. 3, p 369-377, June 1989. 8 fig, 2 tab, 25 ref. Department of Energy contract W-31-109-ENG-38.

Descriptors: *Acoustics, *Instrumentation, *Meteorological data collection, *Rainfall intensity, *Rainfall rate, *Remote sensing, *Sodar, Miniso-

Measurements of raindrop fall velocity spectra have been made with a minisodar. Amplitude cali-

bration of the system enables the calculation of drop size parameters such as number density, water density, and surface area using methods similar to those with Doppler radar studies. The acoustic measurements are at 10 meter intervals within 200 meters of the surface and benefit from an 200 meters of the surface and benefit from an almost complete separation of droplet velocity spectra from atmospheric vertical velocity spectra. Comparison of parameters with those reported in the literature shows good agreement. The chief difficulty with the method is atmospheric attenuation; however, excess attenuation due to scattering from droplets is found to be unimportant. (Author's abstract) W90-06969

EVALUATION OF LIQUID WATER MEASUR-ING INSTRUMENTS IN COLD CLOUDS SAM-PLED DURING FIRE.

National Center for Atmospheric Research, Boulder, CO.

der, CO.

A. J. Heymsfield, and L. M. Miloshevich.
Journal of Atmospheric and Oceanic Technology
JAOTES, Vol. 6, No. 3, p 378-388, June 1989. 7
fig, 1 tab, 24 ref. NASA Contract L98100B, NSF
Grant ATM-85 13975.

Descriptors: *Cloud liquid water, *Ice formation, *Instrumentation, *Meteorological data collection, *Spectrometry, Data interpretation, Troposphere.

Liquid water measurements from the Rosemount icing detector (RICE), Particle Measuring Systems (PMS) forward scattering spectrometer probe (FSSP), and Johnson-Williams and King hot-wire probes used on the NCAR King Air aircraft are evaluated for 10 flights into clouds during the First ISCCP Research Experiment (FIRE). The noise level of the RICE instrument has not previously been defined, and an upper limit is determined by analyzing data collected at temperatures below 40 C, where laboratory measurements and theoretical analyses suggest that all water droplets are frozen, and therefore the liquid water content (LWC) C, where laboratory measurements and theoretical analyses suggest that all water droplets are frozen, and therefore the liquid water content (LWC) should be zero. Similarly, FSSP spectra at temperatures below 40 C are used to place upper bounds on the false signatures produced from contamination by ice particles. The RICE and FSSP 'noise' levels appear to apply to all temperatures between 40 and -20 C as well. The RICE is calibrated for liquid water content measurement by comparing its voltage output with simultaneous FSSP measurements, after removing the noise levels. LWC measurements from the icing detector and the FSSP compare favorably with those from the hot-wire probes in the range where LWC is above the detection limits of the latter (about 0.02 g/cm). The hot-wire probes, which have been used in many past studies in high clouds, have been detection thresholds about one order of magnitude higher than is possible with the RICE and FSSP instruments. Most of the LWC measured at temperatures below -20 C during FIRE fell below the hot-wire probe detection thresholds. A compilation of data from the FIRE experiment indicates that LWC should be taken into consideration in cloud strides at temperatures down to at least -35 that LWC should be taken into consideration in cloud studies at temperatures down to at least -35 C. (Author's abstract)

COMPARISON OF SIMULATED RAIN RATES FROM DISDROMETER DATA EMPLOYING POLARIMETRIC RADAR ALGORITHMS.

National Severe Storms Lab., Norman, OK. N. Balakrishnan, D. S. Zrnic, J. Goldhirsh, and J. Rowland.

Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 6, No. 3, p 476-486, June 1989. 13 fig, 4 tab, 31 ref.

Descriptors: *Algorithms, *Instrumentation, *Meteorological data collection, *Radar, *Rainfall rate, *Simulated rainfall, *Simulation analysis, Error

Employing drop-size distributions obtained with a disdrometer during three spring days with moderate to heavy rain in Norman, Oklahoma, simulated rain rates were derived from various polarimetric radar algorithms. These distributions gave rain

Precipitation—Group 2B

rates that agreed well with those obtained from a nearby rain gauge. Simulated rain rates were derived based on (1) reflectivity at horizontal polarinveit osseu on (1) reliectivity at nonzonial polarization, Zh. (2) differential reflectivity, Zdr (ratio of horizontal to vertical reflectivity factors), (3) differential propagation constant, Kdp. The accuracies of the simulated rain rates from Zh, Zdr, and Kdp are evaluated and compared. Statistical errors and drop size distribution (DSD) variations affect both rodge derived presupercents and distribution affects. both radar derived measurements and disdrometer-simulated rain measurements. DSD variations have the same effects on a given algorithm, but statistical variations are instrument dependent. These two errors cannot be easily separated from observa-tions. The main thrust of simulations with disdrometer data is to reveal the sensitivities of algorithms to DSD variations. Therefore, statistics of instrumental errors have been examined in order to gauge their contribution to the total variability. In the case of differential reflectivity at moderate rainfall rates, statistical errors of radar-derived and rainian rates, statistical errors of radar-terived and simulated measurements are comparable. As a by-product, this study found that a disdrometer might be used instead of a rain gauge to determine needed adjustments, particularly in single-parame-ter radar algorithms. (Chonka-PTT)

DETERMINATION OF RAIN INTENSITY FROM DOPPLER SPECTRA OF VERTICALLY SCANNING RADAR.

Telecommunications Systems Group, Delft, The

W. Klaassen.

Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 6, No. 4, p 522-562, August 1989. 13 fig, 24 ref.

Descriptors: *Data interpretation, *Instrumenta-tion, *Meteorological data collection, *Radar, *Rainfall intensity, *Remote sensing, *Spectral analysis, *Spectrometry, Doppler spectra, Preci-

A new method is given to determine the rain intensity from data collected by a vertically scanning Doppler radar. The method is based on relations ning Doppier radar. The method is based on relat-ing a theoretical velocity spectrum derived from a gamma drop size distribution to the measured Doppler spectra. A considerable reduction in cal-culation time is obtained by characterizing a Dopp-ler spectrum by its total reflectivity and three velocities, and relating these parameters directly to the rain intensity, vertical air velocity and drop size distribution parameters. The method is verified size distribution parameters. The method is verified with observations of a high-resolution radar. A good agreement with the resulting rain intensity is found when large raindrops are present, but the accuracy of the method appears to reduce sharply in the absence of large raindrops. The Doppler spectrum shows a sudden decrease in reflectivity near the maximum fall velocity of raindrops when large enough drops are present. Without large drops, the Doppler spectrum appears hardly sensitive to the mean drop size, and any method that is based on an interpretation of the shape of the Doppler spectrum should be restricted with large raindrops to produce accurate results. (Author's abstract) abstract)

EXPERIMENTAL TESTS OF METHODS FOR THE MEASUREMENT OF RAINFALL RATE USING AN AIRBORNE DUAL-WAVELENGTH RADAR

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. R. Meneghini, K. Nakamura, C. W. Ulbrich, and D. Atlas.

Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 6, No. 4, p 637-651, August 1989. 9 fig, 5 tab, 25 ref.

Descriptors: *Instrumentation, *Measuring instruments, *Meteorological data collection, *Radar, *Rainfall rate, *Remote sensing, Microwave at-

For a spaceborne meteorological radar, the use of frequencies above 10 GHz may be necessary to attain sufficient spatial resolution. As the frequency

increases, however, attenuation by rain becomes significant. To extend the range of rain rates that can be accurately estimated, methods other than the conventional Z-R, or backscattering method, are needed. Tests are made of two attenuation-based methods using data from a dual-wavelength airborne radar operating at 3 cm and 0.87 cm. For the conventional dual wavelength method, the dif-ferential attenuation is estimated from the relative decrease in the signal level with range. For the surface reference method, the attenuation is determined from the difference of surface return powers measured in the absence and the presence of rain. For purposes of comparison, and as an indication of the relative accuracies of the techniques, the backscattering (Z-R), method, as applied to the 3 oackscattering (Z-R), method, as applied to the 3 cm data, is employed. As the primary sources of error for the Z-R, dual wavelength, and surface reference methods are nearly independent, some confidence in the results is warranted when these methods yield similar rain rates. Cases of good agreement occur most often in straitform rain ror. agreement occur most other in stratutors frain rotes between a few mm/hr to about 15 mm/hr, that is, where attenuation at the shorter wavelength is significant but not so severe as to result in a loss of signal. When the estimates disagree, it is sometimes possible to identify the likely error source by an examination of the return power profiles and a knowledge of the error sources.
(Author's abstract)
W90-06973

NUMERICAL STUDY OF THE WARM RAIN PROCESS IN OROGRAPHIC CLOUDS.

PROCESS IN ORGERAPHIC CLOUDS.
Wyoming Univ., Laramie.
N. Song, and J. Marwitz.
Journal of the Atmospheric Sciences JAHSAK,
Vol. 46, No. 22, p 3479-3486, November 15, 1989.
7 fig, 21 ref. DOI Contract 2-07-81-V0256.

Descriptors: *Cloud liquid water, *Mathematical studies, *Model studies, *Orographic precipitation, *Precipitation, *Rain, *Rainfall, Atmospheric water, Clouds, Condensation, Hydrodynamics, Mathematical equations, Numerical analysis,

A technique for numerical simulation of a stationary, two-dimensional laminar flow process is described. In the governing equations for the one-dimensional, time dependent warm rain process, the temperature, pressure and mixing ratio are treated as in a parcel model. The flow is assumed treated as in a parcel mode. In the low is assumed laminar in the vertical. Only sedimentation of hydrometeors is treated in the one-dimensional space. Treatment of microphysics includes an initial droplet spectrum, condensation growth of water droplets, terminal velocity of water drops, and coalescence growth of drops. The numerical methods include an advection scheme for condensation growth and a stochastic collection growth equa-tion solution. The coalescence process depletes the tion solution. The coalescence process depictes the cloud droplets, causing the supersaturation ratio to rise and may cause additional cloud condensation nuclei to activate. The model predicts the initial shape of droplet spectra fairly well for large drops compared with the field observations. There was a discrepancy, however, between the predicted and observed droplet spectra. It was found that the observed coalescence rate was much faster than the calculated rate. This difference could not be the calculated rate. Inis unference could not be explained by giant nuclei or inadequate collision efficiences. The available data suggest that entrainment and inhomogeneous mixing was occurring near cloud top, but the mixing effect could not be fully evaluated. (Friedmann-PTT) W90-06981

ESTIMATING CLIMATIC-SCALE PRECIPITA-

TION FROM SPACE: A REVIEW.

National Oceanic and Atmospheric Administration, Washington, DC. Climate Analysis Center.
For primary bibliographic entry see Field 7B.

W90-07073

RELATIONSHIP BETWEEN CALIFORNIA RAINFALL AND ENSO EVENTS. Florida State Univ., Tallahassee. T. Schonher, and S. E. Nicholson. Journal of Climate JLCLEL, Vol. 2, No. 11, p

1258-1269, November 1989. 8 fig, 4 tab, 40 ref. NSF Grant ATM-8614208.

Descriptors: *California, *Climates, *Climatology, *El Nino/Southern Oscillation, *Precipitation, *Rainfall, *Weather, Rainfall distribution, Seasonal variation. Spatial distribution.

The annual rainfall over California during 11 El Ine annual rannian over Cantorma curing II Ei Nino/Southern Oscillation (ENSO) events within the period 1950 to 1982 are examined. During six of these, unusually wet conditions prevailed throughout California; conditions were near normal during five events; and in one extreme, drought occurred statewide. A comparison with drought occurred statewide. A comparison with the ENSO classification scheme of Fu et al., based on SST patterns in the Pacific, shows an excellent correspondence. Type I years, with large positive temperature anomalies east of the date line and lasting well into winter, are invariably events that enhance California rainfall. Normal years coincide with Type 2 ENSO events (moderate warming over a broad section) the day were the old. Type over a broad sector); the dry year is the sole Type 3 year, with weak anomalies confined to the eastern Pacific. It is also shown that the response to ern Pacific. It is also shown that the response to ENSO is regionally specific. Although throughout the state, most years with extremely wet conditions are ENSO years, the tendency for an ENSO event to increase rainfall is greatest in southern Califor-nia, where 9 of 11 events produced above-normal rainfall and 8 of the 10 wettest years was an ENSO. rainfall and 8 of the 10 wettest years was an ENSO year. The pattern is more complex in central California; there, ENSO years are almost invariably ones with highly abnormal rainfall, but they may be either be wet or dry. The areas least influenced by ENSO are the Sierra Nevada and northern California. The reasons for the geographical pattern of response become apparent when the seasonality and causes of rainfall in the various regions are evaluated. (Author's abstract) W90-07074

SYNOPTIC CLIMATOLOGY OF THE BIMOD-AL PRECIPITATION DISTRIBUTION IN THE UPPER MIDWEST.

Denver Univ., CO. Dept. of Geology and Geogra-

Journal of Climate JLCLEL, Vol. 2, No. 11, p 1289-1294, November 1989. 8 fig. 3 tab, 13 ref.

Descriptors: *Climates, *Climatology, *Precipita-tion, *Rainfall, *Rainfall distribution, Air circula-tion, Meteorological data collection, Rainstorus, Seasonal variation, Temporal distribution, Weather. Weather data collections.

The synoptic climatology of the precipitation regime in the Upper Midwest was investigated. The annual march of precipitation is characterized by a bimodal distribution, with maxima occurring during the months of June and September. Midwight error to the singular distribution, with maxima courring during the months of June and September. Midwight of the precipitation and twice-daily 700 mb height data for the paried 1950, 1979 composits difference mass of the period 1950-1979, composite difference maps of the 700 mb height field corresponding to wet and dry Junes, Augusts and Septembers were constructed to identify the nature of the difference in midtropospheric circulation associated with the midsum-mer minima and the September maxima. Correla-tion of monthly total precipitation with monthly precipitation event frequency was undertaken of determine whether precipitation during the summer months is the result of a small number of high-intensity storms or in fact due to the frequency of less intense rain events. The influence of North Atlantic tropical cyclones on the late summer precipitation was investigated using tropical cylcone tracks and satellite photography. Resulted indicated that (1) the monthly precipitation in the region primarily depends upon the frequenin the region primarily depends upon the frequen-cy of rain events as opposed to a small number of intense storms; (2) the midsummer minima is a result of increased northerly flow aloft of continen-tal origin in response to the building of a ridge to the west; (3) the secondary maxima is associated with a southwestward shift in position of the mean summer trough, producing an increased southwest-erly flow aloft with increased water vapor advec-tion from the Gulf of Mexico; (4) remnant North Atlantic trouval evelopes entering the region can Atlantic tropical cyclones entering the region can

Field 2—WATER CYCLE

Group 2B—Precipitation

organicanus influence the precipitation receipt for a given month, but there is no evidence in the record to indicate that tropical cyclones are the sole mechanism responsible for the September maxima. (Author's abstract)

SOIL MOISTURE AND THE PERSISTENCE OF NORTH AMERICAN DROUGHT. Yale Univ., New Haven, CT. Dept. of Geology and Geophysics For primary bibliographic entry see Field 2G. W90-07076

DOPPLER RADAR ANALYSIS OF THE STRUCTURE OF MESOSCALE SNOW BANDS DEVELOPED BETWEEN THE WINTER MON-SOON AND THE LAND BREEZE.

Meteorological Research Inst., Yatabe (Japan).
M. Ishihara, H. Sakakibara, and Z. Yanagisawa.
Journal of the Meteorological Society of Japan
JMSJAU, Vol. 67, No. 4, p 503-520, August 1989. 15 fig, 2 tab, 23 ref.

Descriptors: *Atmospheric water, *Cloud liquid water, *Clouds, *Meteorology, *Radar, *Remote sensing, *Snow, *Weather, Climates, Doppler sensing, *Snow, *We radar, Japan, Monsoons

The characteristics and structure of mesoscale The characteristics and structure of mesoscale snow clouds generated in the western Hokuriku District of Japan was examined, mainly through Doppler Radar data. These clouds were produced in the convergence zone between the land-originated local wind (land brezze) and the northwesterly monsoon flow. This convergence zone was located monsoon flow. This convergence zone was located in a convective mixed layer over the relatively warm sea producing mesoscale snow bands found along the coast. The snow bands periodically appeared in synoptic situations during which the northwesterly monsoon was not intense and moderately cold air existed in the lower troposphere. erately cold air existed in the lower troposphere. They occurred at an interval of 3-4 days and brought about moderate snowfall to the coastal regions. Their horizontal scale was approximately 100 km by 20 km with a lifetime of 1-1.5 hr, classified as meso-beta-scale phenomena. The land breeze circulation was produced by a thermal context between the warms are and the cold mountain. breeze circulation was produced by a thermal con-trast between the warm sea and the cold mountain-ous land. The cold gravity current associated with the circulation flowed downward toward the sea. The current was modified by the relatively warm sea surface and converged with the northwesterly monsoon flow 10-30 km offshore, producing the snow bands. The snow bands exhibited a marked evolution from the growing stage to the decaying stage, as they moved from the sea to the coast. The successive production of the snow bands resulted from the coupling of three air flows: the north-westerly monsoon, the land breeze and the low-level outflow originating from the anvil-like cloud level outflow originating from the anvil-like cloud at the rear of the snow bands. The low-level con-vergence between the monsoon flow and the land breeze resulted in the development of the snow bands in the growing stage. The pumping of land breeze air into the updraft of the snow bands caused the land breeze front to retreat toward the coast, accompanied by the snow bands. The low-level outflow from the decaying snow bands acted as a trigger or a seed for the formation of a new snow band. The dissipation of the snow band and the extinction of the updraft pumping allowed the front to advance offshore again. (Author's abstract) stract) W90-07077

ANNUAL RAINFALL VARIABILITY AND ITS INTERHEMISPHERIC COHERENCE IN THE SEMI-ARID REGION OF TROPICAL AFRICA. Tokyo Univ. (Japan). Dept. of Geography. M. Shinoda.

Journal of the Meteorological Society of Japan JMSJAU, Vol. 67, No. 4, p 555-564, August 1989. 10 fig, 1 tab, 11 ref.

Descriptors: *Arid zone, *Climates, *Climatology, *Drought, *Precipitation, *Rainfall, *Rainfall distribution, *Tropical regions, Africa, Weather.

The annual rainfall variability and its interhemispheric coherence in the semi-arid region of tropical

Africa was investigated using the data set updated to include 1987 rainfall. The semi-arid region, having an annual rainfall of 200-800 mm, is divided, in terms of geographical location, into six regions: the eastern and western Sahel, East Africa, the northeastern, northwestern, and southern Kalahari. The regions located in the same hemisphere exhibit a high positive correlation, while the interhemispheric correlation is positive but weak. The interhemispheric concurrence of rainfall variation between the western Sahel and northeastern Kalahari is found during the three drought periods; the early 1910s, from the late 1960s to the early 1970s, and the early 1980s. Concurrence was also found for the wet period of the 1950s. However, the for the wet period of the 1930s. However, the 1970s demonstrated a contrasting trend between the hemispheres in that the Sahel experienced a drought, whereas the Kalahari experienced a wet condition. The reduction in rainfall from the early 1950s to the early 1970s was observed in both hemispheres. This resulted from the contraction of the tropical annual rainfall zone, probably associations. ed with the weakening of convective activity over tropical Africa west of West Africa. Subsequently, rainfall continued to decrease only in the Northern Hemisphere until the mid-1980s, accompanied by the retraction toward the equator of the rainfall zone. (Author's abstract) W90-07078

MEASUREMENTS OF WET AND DRY DEPO-SITION IN A NORTHERN HARDWOOD FOREST.

State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 5B.

SIMULATION OF THE LONG-TERM SOIL RESPONSE TO ACID DEPOSITION IN VARIOUS BUFFER RANGES.

Winard Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands). For primary bibliographic entry see Field 5B. W90-07130

EFFECT OF FREEZING ON THE COMPOSI-TION OF SUPERCOOLED DROPLETS-I. RE-TENTION OF HCL, HNO3, NH3 AND H202. Toronto Univ. (Ontario). McLennan Physical

Laos. J. V. Iribarne, and T. Pyshnov. Atmospheric Environment ATENBP, Vol. 24A, No. 2, p 383-387, 1990. 2 fig, 1 tab, 12 ref.

Descriptors: *Acid rain, *Ammonia, *Cloud liquid water, *Hydrochloric acid, *Hydrogen peroxide, *Nitric acid, *Path of pollutants, *Supercooling, Air temperature, Clouds

Experiments were done to check on the possibility that cloud droplets might, during freezing, lose acidity by evolution of hydrochloric or nitric acid, lose ammonia, or lose dissolved hydrogen peroxide. A spray of droplets with an average diame of 39 micrometers was produced by an ultrasor transducer. The droplets acquired a temperature between -8 and -12 C and fell onto an ice surface, where they froze. Appropriate analytical techniques were applied to compare the composition of the frozen droplets with that of the sprayed liquid. It was found that the four chemical species studied were totally retained in the ice after freezing. (See also W90-07232) (Author's abstract)

EFFECT OF FREEZING ON THE COMPOSITION OF SUPERCOOLED DROPLETS-II, RETENTION OF S(IV).

Toronto Univ. (Ontario). McLennan Physical

W. Iribarne, T. Pyshnov, and B. Naik. Atmospheric Environment ATENBP, Vol. 24A, No. 2, p 389-398, 1990. 10 fig, 15 ref, append.

Descriptors: *Acid rain, *Cloud liquid water, *Path of pollutants, *Sulfur, *Supercooling, Air temperature, Clouds, Sulfur dioxide.

Total sulfur—S(IV)—dissolved in droplets is partially evolved as sulfur dioxide during freezing. A spray of droplets with an average diameter 39 micrometers, produced by an ultrasonic transducer, was let to fall through a controlled atmosphere with a known sulfur dioxide concentration, at varying temperatures between -8 and -23 C, attaining thermal and chemical equilibrium. In a first arrangement, the droplets fell by gravitation on an ice surface. Two other arrangements simulated the riming ventilation conditions; in one series of experiments, the droplets were projected by a gas jet riming ventilation conditions; in one series of ex-periments, the droplets were projected by a gas jet at several m/sec against a target; in another, the droplets were caught by rotating rods. The frac-tion of S(IV) retained in the ice (Gamma) was determined by analysis of the samples and compar-sion with the equilibrium concentration in the liquid droplets. Samples collected by gravitation showed a retention coefficient average value Gamma=0.62, independent of temperature. (See also W90-07231) (Author's abstract)

COMPARATIVE STUDY OF PRECIPITATION CHEMISTRY AT INLAND, COASTAL AND ISLAND SITES IN THE BOTHNIAN BAY

Stockholm Univ. (Sweden). Meteorologiska Insti-For primary bibliographic entry see Field 5B. W90-07478

ACID RAIN IN THE UNITED KINGDOM: SPA-TIAL DISTRIBUTIONS AND SEASO VARIATIONS IN 1986. Warren Spring Lab., Stevenage (England). For primary bibliographic entry see Field 5B. W90-07489

DETERMINATION OF HYDROGEN CARBON-

ATE IN RAINWATER.
Warren Spring Lab., Stevenage (England).
J. L. Cocksedge.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-197982.
Price codes: E04 in paper copy. E04 in microfiche.
Report No. LR-657(CS)M, 1988. 9p, 3 tab.

Descriptors: *Acid rain, *Bicarbonates, *Chemical analysis, *Chemistry of precipitation, *Laboratory methods, *Rainfall, Anions, Cations, Hydrogen ion concentration. Water analysis.

As part of the research program of the Department of the Environment, the Air Pollution Division at Warren Spring Laboratory, Stevenage, England, conducts a large long-term project on the monitor-ing of acid rain in the United Kingdom. Quality ing or acid rain in the United Kingdom. Quality assurance and control of data are extremely important and one of the many control measures used in this regard is the ion balance. Many of the imbalances observed show an anion deficit, particularly in samples of high pH. Two analytical methods, the Ion Chromatographic Exclusion and the Ion Selective Electrode, were used for the analysis of rainwater samples of pH above 5.6 to determine hydrogen carbonate (bicarbonate—an anion not otherwise routinely determined) concentration. The results of the two techniques were compared with those obtained by difference calculation from cation and anion analyses routinely performed on these samples. Agreement between the concentrations determined by the three methods was generally good. (Lantz-PTT)

2C. Snow, Ice, and Frost

STRUCTURE OF A LAND BREEZE AND SNOWFALL ENHANCEMENT AT THE LEAD-Hokkaido Univ., Sapporo (Japan). Inst. of Low

Temperature Science. For primary bibliographic entry see Field 2B. W90-06725

Evaporation and Transpiration—Group 2D

NUMERICAL STUDY OF THE INFLUENCE OF ENVIRONMENTAL CONDITIONS ON LAKE-EFFECT SNOWSTORMS OVER LAKE MICHIGAN.

South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences. M. R. Hjelmfelt.

M. K. Hjeinneit.
Monthly Weather Review MWREAB, Vol. 118,
No. 1, p 138-150, January 1990. 9 fig, 7 tab, 48 ref.
NCAR and the FAA through Interagency Agreement DTFA01-82-Y-10513.

Descriptors: *Climatology, *Lake Michigan, *Meteorology, *Model studies, *Simulation analysis, *Snow, *Storms, *Weather, Humidity, Lake effect snowstorms, Numerical models, Storm morphology, Temperature, Wind direction, Wind speed.

Numerical simulations are used to examine the influence of environmental parameters on the morphology of lake effect snowstorms over Lake Michigan. A series of model sensitivity studies are performed using the Colorado State University mesoscale model to examine the effects of lakeland temperature difference, surface roughness, atmospheric boundary layer stability, humidity, and wind speed and direction on the morphology of simulated storms. Four morphological types of lake effect snowstorms have been identified: (1) Broad area coverage, which may become organized into wind parallel bands or cellular convection, (2) shoreline bands with a line of convection roughly parallel to the lee shore and a well developed land breeze on the lee shore; (3) midlake band with low-level convergence centered over the Numerical simulations are used to examine the oped land breeze on the lee shore; (3) midlake band with low-level convergence centered over the lake; and (4) mesoscale vortices with a well-developed cyclonic flow pattern in the boundary layer. The model is able to reproduce all four morphological types. Simulations varying environmental parameters independently define the thermodynamic and wind conditions for the occurrence of each morphological type. In particular, the limiting conditions of lake-land temperature difference, upwind wind speed, stability, and humidity for development of a land breeze on the east side of Lake Michigan are defined for lake snow condi-tions. The effects of wind directions, surface roughness, and latent heat release are also described. (Author's abstract) W90-06807

DEVELOPMENT AND TESTING OF A SNOW-MELT-RUNOFF FORECASTING TECHNIQUE. Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W90-06830

INFLUENCE OF INTERNAL WAVE INDUCED VERTICAL MIXING ON ICE ALGAL PRODUCTION IN A HIGHLY STRATIFIED SOUND

McGill Univ., Montreal (Quebec). Dept. of Meteorology.
For primary bibliographic entry see Field 2L.
W90-07002

DOPPLER RADAR ANALYSIS OF THE STRUCTURE OF MESOSCALE SNOW BANDS DEVELOPED BETWEEN THE WINTER MON-SOON AND THE LAND BREEZE.

Meteorological Research Inst., Yatabe (Japan). For primary bibliographic entry see Field 2B. W90-07077

SNOWFALL CHEMISTRY COLLECTOR IN-TERCOMPARISON TEST (SCCIT). Argonne National Lab., IL. Environmental Research Div.

For primary bibliographic entry see Field 7B. W90-07133

OXYGEN DEMAND IN ICE COVERED LAKES AS IT PERTAINS TO WINTER AERATION. Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab. For primary bibliographic entry see Field 2H. W90-07206

MODELLING WATER TEMPERATURE BE-NEATH RIVER ICE COVERS. National Hydrology Research Inst., Saskatoon (Saskatchewan). For primary bibliographic entry see Field 2H. W90-07235

HYDRAULIC CONDUCTIVITY AND UNFROZEN WATER CONTENT OF AIR-FREE FROZEN SILT. AIR-FREE

Cold Regions Research and Engineering Lab., Hanover, NH. P. B. Black, and R. D. Miller. Water Resources Research WRERAQ, Vol. 26, No. 2, p323-329, February 1990. 8 fig, 23 ref. NSF Grant CEE-8017422.

*Frozen ground, *Soil water, *Hydraulic conductivity, Mathematical analysis, Model studies, Silt, Alaska, Stresses.

Unfrozen water content and hydraulic conductivity data were obtained for an air-free frozen Alaskan silt using a new form of ice sandwich dilatometer/permeameter designed to allow control of effective stress in the granular matrix through appropriate adjustments of pressure in liquid surrounding a specimen confined as in a triaxial test apparatus. Experimental complications included rejuvenation of conductivity during prolonged period of equilibrium (no flow) after each temperature step, immediately followed by very slow but continuing decay, as if without limit. When a formula of the Brooks and Corey type was fitted to unfrozen water content data, hydraulic conductivities inferred from the formula parameter, through the model of Mualem, provided an acceptable decritpion of observed hydraulic conductivity values, as measured immediately after the equilibrium period. (Author's abstract) Unfrozen water content and hydraulic conductivi-

KINEMATIC MODELING OF MULTIPHASE SOLUTE TRANSPORT IN THE VADOSE

Texas Univ. at Austin. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W90-07503

2D. Evaporation and Transpiration

ESTIMATING TOTAL DAILY EVAPOTRAN-SPIRATION FROM REMOTE SURFACE TEM-PERATURE MEASUREMENTS.

nnsylvania State Univ., University Park. Dept.

Pennsylvania State Univ., University Park. Dept. of Meteorology.

T. N. Carlson, and M. J. Buffum.
Remote Sensing of the Environment RSEEA7,
Vol. 29, No. 2, p 197-207, August 1989. 8 fig, 2 tab,
18 ref. NASA grant NAG5-919.

Descriptors: *Evapotranspiration, *Remote sensing, *Soil water, *Thermal radiation, Air temperature, Mathematical equations, Model studies, Simulation analysis, Wind velocity.

A method for calculating daily evapotranspiration from the daily surface energy budget, using re-motely sensed surface temperature and meteoro-logical variables, is presented. Values of the coeffi-cients are determined from simulations with a onedimensional boundary layer model with vegetative cover. Model constants are obtained for vegetation cover. Model constants are obtained for vegetation and bare soil at two air temperature and wind speed levels over a range of surface roughness and wind speeds. The problem with complex models is that they require a detailed set of initial conditions for the atmosphere, surface, and substrate in order to obtain a solution. As a result, semiempirical methods have been proposed for estimating the total daily evapotranspiration integrated over a 24-h period from remotely esneed surface temperature measurements. One such formula, the B-method, arose from analysis of a daily water stress index, which was defined for surface and air temperatures made near 1300 local standard time (LST). The present study addresses the variation in the parampresent study addresses the variation in the parameters B and n in the B-method. These parameters are sensitive to wind speed and roughness, espe-

cially over vegetation. The authors suggest that the B-method might be more generally applicable to regional-scale remote sensing if the reference level for air temperature and wind speed were taken at 50 m, rather than at 2 m because the temperature and wind speed at the 50 m level are relatively insensitive to local surface inhomogeneities. For this reason they show the distribution of ties, For this reason they show the distribution of B and n for air temperatures measured both at the customary 2 m elevation (6.4 m for wind speed) and at 50 m. In view of all the errors inherent in the B-method, it may be sufficiently accurate to use regional-scale surface wind and air temperature measurements and to stratify the wind speed, surface roughness, and vegetation type into just two or three categories. (Author's abstract) W90-06738

EVAPORATION FROM HEATED WATER BODIES: PREDICTING COMBINED FORCED PLUS FREE CONVECTION.

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

E. E. Adams, D. J. Cosler, and K. R. Helfrich. Water Resources Research WRERAQ, Vol. 26, No. 3, p 425-435, March 1990. 7 fig, 3 tab, 39 ref.

Descriptors: *Convection, *Cooling water, *Equations, *Evaporation, East Mesa Site, Savannah River Plant.

Recent measurements at the National Geothermal Test Facility at East Mesa, California, and the Savannah River Plant, South Carolina, have spurred a renewed look at evaporation from heated water bodies. Theoretical analyses are provided for each of four evaporation regimes that could be experienced at heated ponds, ranging from free convective layers to forced convective layers. Differences among regimes are highlighted by calcula-tions appropriate for the Savannah River site where water temperatures reach 70 C and underscore the difficulty in finding a single evaporation equation to adequately cover the entire range. Consequently, a new equation was developed which combines free and forced convection in a which combines free and order convection in a different manner from previous equations: evapo-ration is computed as the square root of the sum of the squares of the respective components. The new equation and several existing equations were compared with evaporation measured at water bodies at the Savannah River and the East Mesa sites. (Author's abstract) W90-06851

POTENTIAL EVAPORATION AND 'COMPLEMENTARY RELATIONSHIP'.

University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
J. E. Nash.

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 1-7, November 1989. 1 fig, 3 ref.

Descriptors: *Evaporation, *Evaporation rate, Complementary relationship, Mathematical analysis, Mathematical equations, Penman equation.

On a cursory reading, the 1948 work of Penman and the 1983 contribution of Morton on evaporaand the 1983 contribution of Morton on evapora-tion seem diametrically opposed. A closer reading, however, shows that they invoke the same concept of potential evaporation. It is shown here that Morton's concept of a complementary relationship between actual and potential evaporation is in no way incompatible with Penman's concept of poten-tial evaporation. A difference in terminology, with some lack of precision in the definition of what was being kept constant, has led to an apparent conflict. The only real conflict between Morton's views and those of Penman arises through Mor-ton's rejection of the assumption that when the water supply is limiting the actual evaporation is ton's rejection of the assumption that when the water supply is limiting the actual evaporation is proportional to the potential evaporation and some function of the water supply. There is no conflict between Penman's and Morton's definitions of potential evaporation, although Morton's is clearer and less open to misinterpretation. Morton's use of the complementary relationship extends rather than contradicts Penman's work. This extension permits estimation of actual rather than potential

Field 2—WATER CYCLE

Group 2D-Evaporation and Transpiration

evaporation, thus avoiding the necessity of assuming an empirical relationship between actual and potential evaporation as a function of soil moisture deficiency. (Rochester-PTT) W90-0588

EXAMINATION OF THE CONCEPT OF PO-TENTIAL EVAPORATION, Saskatchewan Univ., Saskatoon. Div. of Hydrolo-

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 9-19, November 1989. 1 fig, 1 tab, 22 ref.

Descriptors: *Evaporation, *Evaporation rate, Energy, Mathematical analysis, Mathematical equations, Water vapor.

A survey of the literature reveals that the concept A survey of the interature reveals that the concept of potential evaporation has been the source of some ambiguity. Multiple 'definitions' exist that in fact can represent several distinct parameters. A systematic approach was used to derive a series of distinct 'potential evaporation parameters.' The evaporating surface is considered as a system to and from which energy and vapor can be transferred; the potential evaporation parameters de-scribe the evaporation rates that occur when prescribed changes, including saturating the surface, are imposed on this system. Of the defined potential evaporation parameters, the most useful are: (1) the 'equilibrium' evaporation rate, which is governed solely by the available energy and represents a lower limit to evaporation from moist surfaces; (2) the 'wet surface' evaporation, which is governed by the available energy and atmospheric considerations and is represented by the Pennan equation; and (3) the 'potential' evaporation, which is defined by the atmospheric conditions and the saturation vapor pressure at the actual surface temperature and represents an upper limit to evapora-tion from a moist surface. (Author's abstract)

EVAPORATION FROM NATURAL NONSA-TURATED SURFACES. Saskatchewan Univ., Saskatoon. Div. of Hydrolo-

gy. R. J. Granger, and D. M. Gray. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 21-29, November 1989. 2 fig, 14 ref.

Descriptors: *Evaporation, *Evaporation rate, Energy, Heat flux, Mathematical analysis, Mathematical equations, Relative evaporation, Soil tem-

Following a development similar to that used by Penman in 1948, a general combination equation is derived to describe evaporation from nonsaturated surfaces. To account for departure from saturated conditions, the equation utilizes the concept of relative evaporation, the ratio actual:potential evaporation, defined here as the evaporation rate that would occur under the existing atmospheric conditions if the surface were saturated at the actual surface temperature. A relationship is estabactual surface temperature. A relationship is estab-lished between the relative evaporation and a di-mensionless parameter called 'relative drying power,' the ratio drying power-drying power + net available energy (i.e., net radiation + soil heat flux). The relationship is non-dimensional and ap-pears to be single-valued. The combination of this relationship with the general evaporation equation derived constitutes a simple model for obtaining estimates of evaporation from nonsaturated sur-faces; no prior estimate of the notential evaporafaces; no proporation from nonsaturated surfaces; no prior estimate of the potential evapora-tion is required and the surface conditions of tem-perature and humidity need not be known. (Au-thor's abstract) W90-06883

COMPLEMENTARY RELATIONSHIP PROACH FOR EVAPORATION FROM NON-SATURATED SURFACES.

Saskatchewan Univ., Saskatoon. Div. of Hydrolo-

gy. R. J. Granger. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 31-38, November 1289.

Descriptors: *Evaporation, *Evaporation rate, Complementary relationship, Mathematical analysis, Mathematical equations, Relative evaporation.

The complementary relationship between actual and potential evaporation introduced in 1963 by Bouchet is evaluated. Definitions for the potential nd wet-surface evaporation rates are ch allow both these parameters to be derived from the allow both these parameters to be derived from the energy balance and mass transfer equations, and to be expressed in terms of appropriate vapor pressure gradients. Using a development similar to that of Bouchet, the general form of the relationship among the actual evaporation (E), the potential evaporation (Ep) and the potential evaporation when the actual regional evaporation equals the potential rate (Epw) is then derived. The resulting equation, unlike Bouchet's shows that changes in potential rate (cpw) is then derived. The resulting equation, unlike Bouchet's, shows that changes in actual and potential evaporation are not equal. By introducing the concept of 'relative' evaporation (G = E/Ep), the modified complementary relationship reduces to a general equation describing consulp reduces to a general equation describing evaporation from nonsaturated surfaces. Thus, both the combination approach and complementa-ry relationship yield the same result. (Author's abstract) W90-06884

DEVELOPMENT OF A SYSTEM TO ESTI-MATE EVAPOTRANSPIRATION OVER COM-PLEX TERRAIN USING LANDSAT MSS, ELE-VATION AND METEOROLOGICAL DATA.

Tsukuba Univ. (Japan). Science Information Processing Center.
T. Hoshi, S. Uchida, and K. Kotoda.

Hydrological Sciences Journal HSJODN, Vol. 34, No. 6, p 635-649, December 1989. 7 fig, 5 tab, 9 ref.

Descriptors: *Elevation, *Evapotranspiration, *Hydrologic cycle, *Meteorological data collection, *Remote sensing, *Satellite technology, *Topography, Altitude, Estimating, Statistical methods, Stomatal transpiration, Transpiration.

In order to estimate areal evapotranspiration (ET), a system using Landsat MSS and elevation data was developed. After extraction of the study area and its geometric correction, Landsat MSS data are classified into land use categories, which give empirical parameters for calculation of ET. Elevation data, which are originally given at the mesh of 7.5 seconds in latitude by 11.25 seconds in longitude, are interpolated and fitted to each pixel of land use image data. Calculation of ET is executed by using empirical functions in terms of meteoroby using empirical functions in terms of meteoro-logical elements which are linearly regressed with elevation from data at several observatories. The calculated results are represented by the form of not only statistical quantities but also transformed image data. The distribution of ET over mountainimage data. The distribution of ET over mountain-ous areas, represented as image data, reasonably shows the effect of topography. After comparing with observed data of pan evaporation and with the values estimated by Thornthwaite's method, it can be concluded that this system would reliably estimate the actual monthly ET over large areas. (Author's abstract)

PATTERNS OF STRATIFIED SOIL WATER LOSS IN CHIHUAHUAN DESERT COMMUNI-

San Diego State Univ., CA. Systems Ecology Research Group. bibliographic entry see Field 2G.

2E. Streamflow and Runoff

CILIATED PROTOZOAN COMMUNITIES IN A FLUVIAL ECOSYSTEM. Barcelona Univ. (Spain). Facultat de Biologia For primary bibliographic entry see Field 2H.

EROSION, PHOSPHORUS AND PHYTO-PLANKTON RESPONSE IN RIVERS OF SOUTH-EASTERN NORWAY.

Norges Landbrukshoegskole, Aas. Dept. of Soil Sciences.

For primary bibliographic entry see Field 2H. W90-06582

DOWNSTREAM DRIFT OF THE LARVAE OF CHIRONOMIDAE (DIPTERA) IN THE RIVER CHEW, S. W. ENGLAND.

Bristol Univ. (England). Dept. of Zoology. For primary bibliographic entry see Field 2H. W90-06584

MACROINVERTEBRATE COMMUNITIES IN WHEELER RESERVOIR (ALABAMA) TRIBU-TARIES AFTER PROLONGED EXPOSURE TO DDT CONTAMINATION.

Auburn Univ., AL. Dept. of Fisheries and Allied For primary bibliographic entry see Field 5C.

ROTIFER OCCURRENCE IN RELATION TO OXYGEN CONTENT.
Uppsala Univ. (Sweden). Limnologiska Institu-

For primary bibliographic entry see Field 2H. W90-06589

INFLUENCE OF DIFFERENT LITTER BAG DESIGNS ON THE BREAKDOWN OF LEAF MATERIAL IN A SMALL MOUNTAIN

Cape Town Univ. (South Africa). Dept. of Water Resources and Public Health Engineering. For primary bibliographic entry see Field 7B. W90_06590

DECOMPOSITION RATE OF PLANT MATERIAL IN THE PARANA MEDIO RIVER (AR-

Centro de Estudios del Agua, Santa Fe (Argenti-For primary bibliographic entry see Field 2H. W90-06591

URUGUAYIAN WATER-PRIMROSE (LUDWI-GIA URUGUAYENSIS) IN TENNESSEE AND

Austin Peay State Univ., Clarksville, TN. For primary bibliographic entry see Field 2H. W90-06597

INVESTIGATION OF ORCONECTES SHOUPI IN MILL AND SEVENMILE CREEKS, TEN-

Army Engineer Waterways Experiment Station, Vicksburg, MS. For primary bibliographic entry see Field 2H.

PHYSICAL HABITAT SELECTION BY BROWN TROUT (SALMO TRUTTA) IN RIVER-INE SYSTEMS.

Norges Landbrukshoegskole, Aas. Dept. of Nature For primary bibliographic entry see Field 2H. W90-06600 Conservation.

PHENOLOGY OF THE CLADOPHORA-STI-GEOCLONIUM COMMUNITY IN TWO URBAN CREEKS OF MELBOURNE, Melbourne Univ., Parkville (Australia). Dept. of Botany.

For primary bibliographic entry see Field 2H. W90-06657

EFFECTS OF HYPOXIA ON OXYGEN CON-SUMPTION BY TWO SPECIES OF FRESHWA-TER MUSSEL (UNIONACEA:HYRIIDAE) FROM THE RIVER MURRAY.

Adelaide Univ. (Australia). Dept. of Zoology. For primary bibliographic entry see Field 2H.

W90-06658

IMPACT OF TIMBER HARVESTING AND PRODUCTION ON STREAMS: A REVIEW. Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology. For primary bibliographic entry see Field 4C. W90-06659

CONVERSION OF THE DIGITAL LAND INFORMATION FILES FOR THE PURPOSE OF DRAWING RIVER BED PROFILES. Tokyo Univ. (Japan).
For primary bibliographic entry see Field 7C.
W90-06661

DIFFERENTIATION OF THE HABITATS OF HYDROPSICHIDAE LARVAE (INSECTA: TRI-CHOPTERA) IN THE PASLEKA RIVER AS A RESULT OF AVOIDANCE OF TROPHIC COM-PETITION

Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Inst. of Biology. For primary bibliographic entry see Field 2H. W90-06695

LABORATORY STUDIES OF THE EFFECT OF AN ANIONIC DETERGENT AND FUEL OIL ON THE LEVELS OF CHLOROPHYLL OXYGEN AND TOTAL SUSPENDED PARTIC-ULATE MATTER IN WATER OF THE BRDA

Akademia Medyczna, Bydgoszcz (Poland). Dept. of Biology. For primar W90-06697 ary bibliographic entry see Field 5C.

PRODUCTIVE CAPACITY OF PERIPHYTON AS A DETERMINANT OF PLANT-HERBI-VORE INTERACTIONS IN STREAMS.

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife. For primary bibliographic entry see Field 2H. W90-06704

RETENTION AND TRANSPORT OF NUTRI-ENTS IN A THIRD-ORDER STREAM: CHAN-NEL PROCESSES.

Geological Survey, Menlo Park, CA. Water Resources Div. For primary bibliographic entry see Field 2H. W90-06705

RETENTION AND TRANSPORT OF NUTRI-ENTS IN A THIRD-ORDER STREAM IN NORTHWESTERN CALIFORNIA: HYPOR-HEIC PROCESSES.

Geological Survey, Menlo Park, CA. Water Re-For primary bibliographic entry see Field 2H. W90-06706

OCEANIC AND RIVERINE INFLUENCES ON VARIATIONS IN YIELD AMONG ICELANDIC STOCKS OF ATLANTIC SALMON. Iowa State Univ., Ames. Dept. of Animal Ecolo-

gy.
For primary bibliographic entry see Field 2H.
W90-06740

SPAWNING HABITAT AND REDD CHARAC-TERISTICS OF SOCKEYE SALMON IN THE GLACIAL TAKU RIVER, BRITISH COLUMBIA

AND ALASKA. National Marine Fisheries Service, Auke Bay, AK. For primary bibliographic entry see Field 2H. W90-06741

REGIONAL EXCEEDANCE PROBABILITIES. Oslo Univ. (Norway). Inst. of Geophysics. For primary bibliographic entry see Field 7C. W90-06810

PROPOSED SWEDISH SPILLWAY DESIGN FOODS IN RELATION TO OBSERVATIONS AND FREQUENCY ANALYSIS. Sveriges Meteorologiska och Hydrologiska Inst.,

Norrkoeping. For primary b W90-06815 bibliographic entry see Field 8B.

PROPOSED SWEDISH SPILLWAY DESIGN GUIDELINES COMPARED WITH HISTORI-CAL FLOOD MARKS AT LAKE SILJAN. Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
For primary bibliographic entry see Field 8B.
W90-06816

MODELING RAINFALL-RUNOFF PROCESS INCLUDING LOSSES.
Academia Sinica, Beijing (China), Inst. of Geogra-

phy. G.-T Wang, and Y.-S. Yu. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 61-66, February 1990. 3 fig, 2 tab, 13 ref.

Descriptors: *Hydrologic models, *Model studies, *Rainfall, *Rainfall-runoff relationships, *Runoff, Autoregressive moving average model, Nonlinear iterative technique.

Existing discrete, linear rainfall-runoff models generally require the effective rainfall of a given storm as the input for computing the runoff hydrograph. A method is proposed for estimating, simultaneously, the optimal values of model parameters and the rainfall losses from the measured rainfall hyetograph and the runoff hydrograph. The method involves an ARMA (autoregressive/moving average) model for the rainfall-runoff process and a nonlinear iterative technique. The number of model parameters to be estimated for the ARMA model is much less than the unit hydrograph model. Applications of the model to three different watersheds show that the computed runoff hydrographs agree well with the measure-Existing discrete, linear rainfall-runoff models genrunoff hydrographs agree well with the measure ments. (Author's abstract) W90-06823

TRENDS IN FRESHWATER INFLOW TO SAN FRANCISCO BAY FROM THE SACRAMENTO-SAN JOAQUIN DELTA. Consulting Engineer, 2530 Etna Street, Berkeley, California 94704.

Cantorna 34/04. J. P. Fox, T. R. Mongan, and W. J. Miller. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 101-116, February 1990. 5 fig, 5 tab, 41 ref.

Descriptors: *California, *Sacramento River, *Saline-freshwater interfaces, *San Francisco Bay, *San Joaquin River, Flood control, Groundwater, Land use, Rainfall, Runoff, Seasonal variation, Water resources development.

Outflow from the Sacramento-San Joaquin river system (Delta outflow) provides about 90 percent of the freshwater flow to San Francisco Bay. Because this river system also supplies most of the water used in California, some believed that annual freshwater flow to the Bay had declined by as much as 50 to 60 percent as water use increased. Consequently, trends in actual Delta outflow and precipitation for the period 1921 to 1986, which is when Delta outflow data are available were studied. It was found that there has been no decrease in the annual Delta outflow over this period. In fact, a statistically significant increase in annual Delta outflow has increased is because precipitation has increased faster than water use. Other contributing factors include increased runoff from land use changes, water imports from other areas, and the redistribution of ground water. In addition, statistically significant easonal trends in Delta outflow were found. Over the period 1921-1986 Delta outflow decreased in April and May and increased from July through November. Changes in other months were not statistically significant. These seasonal changes result primarily from the operation of upstream flood control and water development projects, which store water in the spring and reprojects, which store water in the spring and re-

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lease it in the summer and fall. These seasonal changes are also influenced by a climatic shift that has decreased spring snowmelt runoff and in-creased late summer through winter precipitation. (Author's abstract)

DEVELOPMENT AND TESTING OF A SNOW-MELT-RUNOFF FORECASTING TECHNIQUE. Agricultural Research Service, Beltsville, MD. Hydrology Lab. For primary bibliographic entry see Field 2A. W90-06830

COMPARISON OF REGIONAL FLOOD FRE-QUENCY ESTIMATION METHODS USING A RESAMPLING METHOD.

Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
K. W. Potter, and D. P. Lettenmaier.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 415-424, March 1990. 6 fig, 1 tab, 15 ref.

Descriptors: *Flood forecasting, *Flood freque cy, *Statistical methods, Estimating, New En-land, Statistics, Wisconsin.

Most comparisons of flood frequency estimation methods have been based on Monte Carlo simulation. An alternative method which does not require the choice of a parent distribution is to resample from the historical record. The relative performance of 10 flood frequency estimation methods, including four at-site methods, four regional index flood methods, and two variations of the U.S. Water Resources Council regional gional index flood methods, and two variations of the U.S. Water Resources Council regional method, was evaluated using a resampling method. Performance measures were based on two statis-tics. The first was a flood damage surrogate, which was defined as a power of the excess of the flood peak over a fixed threshold approximately equal to the median annual flood; the second was the esti-mator of the 100-year flood. For each subsampling of the historical record, the expected flood loss and 100-year flood quantile conditioned on the estimat-der parameters were computed. From the remain-der of the record, an empirical estimate of the mean damage was computed. The performance of the methods is summarized in terms of the mean and variance of the difference between the condi-tional expectation and the empirical damages, and and variance of the difference between the condi-tional expectation and the empirical damages, and the variance of the 100-year flood estimates. The results are qualitatively similar to those reported in earlier Monte Carlo studies. The U.S. Water Re-sources Council method, in particular, produced variability in the damage estimates that was much greater than that for any of the index flood meth-ods tested. Estimates of the 100-year flood were about twice as variable on average as 100-year food estimates obtained using any of the regional index flood methods. For the Wisconsin and New England flood records tested, the regional Gener-alized Extreme Value estimators yielded 100-year flood estimates with lower variability at virtually all sites than the U.S. Water Resources Council method. (Author's abstract) W90-06850 W90-06850

DETERMINING THE MEAN DEPTH OF OVERLAND FLOW IN FIELD STUDIES OF FLOW HYDRAULICS.

State Univ. of New York at Buffalo. Dept. of

State Only. Of Teek 120 Geography.

A. D. Abrahams, and A. J. Parsons.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 501-503, March 1990. 1 fig, 1 tab, 7 ref. NATO Grant RG 85/0066.

Descriptors: *Hydraulics, *Ov *Runoff, *Runoff forecasting, Rills. *Overland flow,

In field studies of interrill overland flow conducted on runoff plots, the mean depth of flow is usually obtained by averaging measurements of flow depth at regularly spaced points across the plot, including points where there is no flow. Although this procedure may be appropriate in studies aimed at runoff prediction, it is not in studies concerned with flow hydraulics. In the latter studies, more

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realistic results can be obtained by excluding those reassic results can be obtained by excluding those points where the depth is zero and reducing the width of flow in proportion to the number of points excluded. Failure to do this results in the underestimation of the actual mean flow depth, Reynolds number, and friction factor. Where discharges are small or microtopography is large, this underestimation is likely to be significant. (Author's abstract) W90-06859

MODELING TRANSIENT STORAGE AND NI-TRATE UPTAKE KINETICS IN A FLUME CONTAINING A NATURAL PERIPHYTON COMMUNITY.

California Univ., Davis. Dept. of Chemical Engi-For primary bibliographic entry see Field 5B. W90-06860

SIMPLE SUBSAMPLING DEVICE FOR MA-CROINVERTEBRATES WITH GENERAL RE-MARKS ON THE PROCESSING OF STREAM BENTHOS SAMPLES.

Konstanz Univ. (Germany, F.R.). Limnological

For primary bibliographic entry see Field 7B. W90-06878

ONE-DIMENSIONAL FLOW OVER A PLANE: CRITERIA FOR KINEMATIC WAVE MODEL-

Department of Scientific and Industrial Research, Christchurch (New Zealand). Hydrology Centre. C P Pearson

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 39-48, November 1989. 7 fig, 16 ref.

Descriptors: *Kinematic waves, *Mathematical models, *Model studies, *Runoff, *Shallow water, *Unsteady flow, Froude number, Hydrologic models, Mathematical equations, New Zealand, Overland flow, St Venant equation, Stream dis-

Criteria for using the kinematic wave approxima-tion to the Saint Venant equations for shallow water flow are examined. Attention is focused on water flow are examined. Attention is focused on the steady-state upstream depth, which, for the condition of zero flow at the upstream boundary, is generally non-zero (proven mathematically) but in the kinematic approximation is implicitly assumed to be zero. Conditions when the upstream depth tends to zero were investigated and served to verify the existing criteria for using the kinematic wave approximation to the Saint Venant equations. The criteria were used to crudely check the validi-ty of kinematic wave routing of overland flow and streamflow in the Waihopai River catchment, southern New Zealand. The use of solutions em-ploying one-dimensional flow over a plane, particularly those of kinematic wave approximation, for catchment runoff modeling has to be conductfor catchment runoff modeling has to be conducted over appropriate catchment geometries to give realistic results. Representing a catchment as one or two planes only is unlikely to improve upon simpler, conceptual models. Greater computer power will facilitate evaluation of using a large number of inflitrating overland flow planes for modelling the rainfall-runoff process on a catchment-wide scale. Contours of dimensionless steady-state upstream depth over a two-parameter plane are used to obtain a further criterion for kinematic wave modeling. The new criterion is consistent with, and improves upon, the existing criteria. with, and improves upon, the existing criteria.
(Rochester-PTT)
W90-06885

SEDIMENT CONCENTRATION WATER DISCHARGE DURING SINGLE HY-DROLOGIC EVENTS IN RIVERS. Geological Survey, Denver, CO. For primary bibliographic entry see Field 2J. W90-06888

STREAMFLOW MODEL USING PHYSICAL-LY-BASED INSTANTANEOUS UNIT HYDRO- Georgia Inst. of Tech., Atlanta. School of Civil

Georgia Inst. of Tech., Adama. School of Civil Engineering. A. P. Georgakakos, and J. C. Kabouris. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p. 107-131, November 1989. 14 fig., 7 tab, 27 ref. USGS Grant G-1011 and Georgia Power Compa-ny Research Project POE-06608.

Descriptors: *Catchment areas, *Georgia, *Hydrograph analysis, *Hydrologic models, *Streamflow, *Unit hydrographs, Little River, Markov process, Mathematical studies, Temporal distribution.

The Geomorphologic Instantaneous Unit Hydrograph watershed modeling approach is extended to account for subsurface runoff. Watershed response to rainfall is modeled as a Markov process, the parameters of which can be related to physical watershed characteristics. Time-varying instantaneous unit hydrographs subsequently are derived and convoluted with antecedent rainfall intensities and convoluted with antecedent rainfall intensities to generate total streamflow discharges. This watershed model was applied to the Little River watershed, southeastern Georgia. Predicted streamflows were in good agreement with stream gage measurements. The proposed model can account for spatial variations in geomorphologic watershed characteristics, land usage, and rainfall depth. Also, it can be integrated into a real time storm tracking and flood forecasting scheme. (Author's abstract) thor's abstract)

DISTRIBUTED MUSKINGUM MODEL.
Polish Academy of Sciences, Warsaw. Inst. of
Geophysics.

W. G. Strupczewski, J. J. Napiorkowski, and J. C.

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 235-257, November 1989. 4 fig, 22 ref, append.

Descriptors: *Flood control, *Flood routing, *Hydrologic models, *Model studies, *Muskingum model, *Routing, Errors, Mathematical analysis, Mathematical equations, St Venant equation, Venant equation, Stream discharge.

The limiting form of the multiple Muskingum model was investigated for the case when the number of reaches increases to infinity while maintaining finite values for the first and second moments. Both the cumulants and the amplitude and phase characteristics of this distributed Muskingum model (DMM) are derived. The model is compared to the solution of this linearized Saint-Venant equation for a semi-infinite uniform channel. The error of the DMM in predicting the third central moment of the LSV is shown to be independent of channel learners. pendent of channel length, in contrast to the classic Muskingum model in which the error increases rapidly with length of channel. (Author's abstract) W90-06897

APPROXIMATE ANALYSIS OF SURFACE RUNOFF MODEL UNCERTAINTY. Williamson and Schmid, Irvine, CA. T. V. Hromadka, and R. H. McCuen. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 321-360, November 1989. 16 fig, 3 tab, 18 ref.

Descriptors: *Hydrologic models, *Mathematical models, *Rainfall-runoff relationships, *Streamflow forecasting, *Surface runoff, *Uncertainty, Errors, Statistical analysis, Stochastic hydrology.

Recent work of Schilling and Fuchs is useful in Recent work of Schilling and Fuchs is useful in evaluating the potential success of a surface runoff model in reliably predicting the runoff response at a stream gage from a catchment, given rainfall data from a single rain gage. The present work approximates the uncertainty in runoff predictions from the Schilling and Fuchs method by coupling to the rainfall-runoff model a stochastic model that represents the error between measured runoff data and model estimates of runoff. The stochastic model is model estimates of runoff. The stochastic model is developed using a multilinear model of either the catchment runoff itself, or a multilinear equivalent to some particular surface runoff modeling approach. From this coupled model, distributions of the predicted outcomes of criterion variables (e.g., peak flow rate detention basin maximum volume)

can be obtained and confidence intervals can be estimated and used in flood control planning. Once the distribution of the predicted outcomes of the criterion variable is developed, T-year estimates of the criterion variable are evaluated. New notation is introduced to unify the theory of uncertainty as applied to rainfall-runoff models. (Rochester-PTT) W90-06901

OPERATIONAL GLS MODEL FOR HYDRO-LOGIC REGRESSION.

Geological Survey, Reston, VA. Water Resources

G. D. Tasker, and J. R. Stedinger. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 361-375, November 1989. 2 fig, 22 ref, append.

Descriptors: *Catchment areas, *Flood forecasting, *Hydrologic models, *Least squares method, *Model studies, Correlation analysis, Errors, Generalized least squares procedures, Mathematical analysis, Monte Carlo method, Statistics, Stream gages, United States Geological Survey.

The US Geological Survey has for some time employed regional models that estimate statistics at ungaged locations and for sites with very short records by use of physiographic characteristics of a catchment, including drainage area, main-channel slope, and land-use and land-cover statistics; meteorological variables, such as mean annual precipitation and appropriate statistics and a specific production and support of the statistics and a specific production and support of the statistics and a specific production and support of the statistics and a specific production and support of the statistics and a specific production and support of the statistics and a specific production and support of the statistics are also employed. tion and snowpack statistics are also employed. Recent Monte Carlo studies have documented the Recent Monte Carlo studies have documented the value of generalized least squares (GLS) procedures to estimate empirical relationships between streamflow statistics and physiographic basin characteristics. A number of extension of the GLS method are presented that deal with the realities and complexities of regional hydrologic data sets that were not addressed by earlier simulation studies. These extensions include: a more realistic model of the underlying model errors; (2) smoothed estimates of cross correlation of flows; (3) procedures for including historical flow data; (4) diagnostic statistics describing leverage and influence of GLS regression; and (5) the formulation of a mathematical program for evaluating future gaging activities of the United States Geological Survey. (Author's abstract)

UNIT HYDROGRAPH STABILITY AND LINEAR ALGEBRA.

LINEAR ALGEBRA. University Coll., Galway (Ireland). Dept. of Engineering Hydrology. J. C. I. Dooge, and M. Bruen. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 377-390, November 1989. 21 ref, append.

Descriptors: *Data quality control, *Errors, *Hydrograph analysis, *Mathematical analysis, *Streamflow forecasting, *Unit hydrographs, Least squares method, Linear algebra, Rainfall-runoff relationships, Storm runoff.

The feasibility is explored of using concepts from linear algebra such as the condition number as a basis for studying the conditions under which data basis for studying the conditions under which data error causes unacceptable instabilities in unit hydrographs. The condition number, which provides an upper bound for the amplification of error, is shown to depend on the shape of the input time series and the method of deriving the unit hydrograph. A number of methods (forward substitution, Collins method, least squares, and smoothed least squares) were compared for the highly simplified case of a two-ordinate unit hydrograph for which a closed form solution can be obtained in each case. The condition number does not have a finite limit for any of the methods that solve directly some of for any of the methods that solve directly some of the convolution equations, but does have a finite limit for the least-squares methods, both uncon-strained and smoothed. This finite limit is an in-creasing function of the length of the input data series and its lag-one autocorrelation. The analyticel results for the forward substitution method confirm the conclusions from numerical experimentation that the amplification of error is greater for this method when the intensity of effective rainfall increases rather than decreases during a storm. The better performance of the Collins method compared to forward substitution for most inputs is explained by the condition number. The results of this simplified analysis are sufficiently encouraging to warrant further studies of this type on more complex storms, longer unit hydrographs, and other methods of unit hydrograph derivation. (Rochester-PTT) W90-06903

EPISODIC VARIATIONS IN STREAMWATER ALUMINUM CHEMISTRY AT BIRKENES, SOUTHERNMOST NORWAY.

Senter for Industriforskning, Oslo (Norway). For primary bibliographic entry see Field 5B. W90-06936

ALUMINUM SPECIATION AND ORGANIC CARBON IN WATERS OF CENTRAL ONTAR-

Ontario Ministry of the Environment, Toronto. For primary bibliographic entry see Field 5B. W90-06938

ALUMINUM SPECIATION AND TOXICITY IN UPLAND WATERS,

Water Research Centre, Medmenham (England). For primary bibliographic entry see Field 5B.

ORGANIC CARBON IN WATERS OF THE WHITE SEA DURING THE SUMMER OF 1984. All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR). For primary bibliographic entry see Field 5B. W90-06957

INDUCED CHANNEL ENLARGEMENT IN SMALL URBAN CATCHMENTS, ARMIDALE, NEW SOUTH WALES. Chinese Univ. of Hong Kong, Shatin. Dept. of

Geography.
For primary bibliographic entry see Field 4C.
W90-06959

EPHEMERAL FOREST DRAINAGE DITCH AS A SOURCE OF ALUMINIUM TO SURFACE WATERS.

Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 5B. W90-06976

INORGANIC ALUMINIUM-HYDROGEN ION RELATIONSHIPS FOR ACIDIFIED STREAMS; THE ROLE OF WATER MIXING PROCESSES. Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 5B. W90-06977

PREDICTING THE LONG-TERM VARIATIONS IN STREAM AND LAKE INORGANIC ALUMINIUM CONCENTRATIONS FOR ACIDIC AND ACID SENSITIVE CATCH-MENTS.

Institute of Hydrology, Wallingford (England For primary bibliographic entry see Field 5B. W90-06978

SOURCES AND STORM LOADING VARIATIONS OF METAL SPECIES IN A GULLY-

ATIONS OF METAL SPECIES IN A GULLY-POT CATCHMENT. Middlessx Polytechnic, Enfield (England). Urban Pollution Research Center. For primary bibliographic entry see Field 5B. W90-06980

TRANSPORT OF CARBON, NITROGEN AND PHOSPHORUS IN A BRITTANY RIVER,

Bretagne-Occidentale, Universite de (France). Station Biologique.
For primary bibliographic entry see Field 5B. W90-07006

PROBLEMS OF SNOWMELT RUNOFF MODELLING FOR A VARIETY OF PHYSIOGRAPHIC AND CLIMATIC CONDITIONS.

Geological Survey, Denver, CO.
G. H. Leavesley.
Hydrological Sciences Journal HSJODN, Vol. 34,
No. 6, p 617-634, December 1989. 71 ref.

Descriptors: *Climates, *Geomorphology, *Hydrologic cycle, *Hydrologic models, *Model studies, *Runoff, *Runoff forecasting, *Snow, *Snowmelt, Algorithms, Remote sensing, Runoff cycle, Runoff rates, Runoff volume, Snow accumulation, Uncertainty.

Snowmelt runoff is a significant component of the hydrological cycle in many regions. Major problems of snowmelt runoff modeling associated with lems of snowmett runoit modeling associated with the physiographic and climatic conditions of these regions, and solutions being investigated, are re-viewed. Problems common to all regions include: (a) definition of the spatial and temporal distribu-tion of model input; (b) measurement or estimation of snow accumulation, snowmet, and runoff proc-ess parameters for a range of applications and ess parameters for a range or appinations and scales; and (c) development of accurate short term and long term snowmelt runoff forecasts. Proce-dures being investigated to solve these problems include: (a) integrating conventional and remoteinclude: (a) integrating conventional and remote-sensing data to improve estimates of input data; (b) developing snowmelt process algorithms that have parameters that are closely related to measurable basin and climatic characteristics; and (c) updating model parameters and components using measured data or knowledge of past uncertainty. Research needs include development of improved model ca-pabilities and establishment of standardized tech-niques and measures to evaluate model perform-ance and results. (Author's abstract)

CHEMISTRY OF STREAMS DRAINING GRASSLAND AND FOREST CATCHMENTS AT PLYNLIMON, MID-WALES. CHEMISTRY

Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station. For primary bibliographic entry see Field 2K. W90-07024

WATER QUALITY MODEL FOR THE TIGRIS RIVER DOWNSTREAM OF SADAM DAM, IRAQ. Mosul Univ. (Iraq). Saddam Dam Research

Centre. For primary bibliographic entry see Field 7C. W90-07025

RISK ASSESSMENT AND DROUGHT MAN-AGEMENT IN THE THAMES BASIN. Institute of Hydrology, Wallingford (England). R. J. Moore, D. A. Jones, and K. B. Black. Hydrological Sciences Journal HSJODN, Vol. 34, No. 6, p 705-717, December 1989. 9 fig, 1 tab, 6 ref.

Descriptors: *Drought, *Management planning, *Reservoir operation, *Risk assessment, *Storage reservoirs, *Thames River Basin, *Water deficit, *Water scarcity, *Water yield improvement, *Watershed management, Meteorological data collection, Rainfall-runoff relationships, Statistical methods, Water management, Water shortage.

A risk assessment procedure is presented for use in managing a system of pumped-storage reservoirs in the Thames basin during a drought. Historical daily rainfall sequences are used as equi-probable scenarios of future rainfall. These are transformed to flow, reservoir level, and demand restriction nences through the use of rainfall-runoff and water resource system models. The risk assessment water resource system models. The risk assessment information required is then obtained through a statistical analysis of these sequences. A novel technique is presented for incorporating monthly rainfall forecasts, presented as probabilities of rainfall being above average, average, or below average, into the risk assessment scheme. Information on current hydrological conditions is incorporated

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in the procedure through the use of recently ob-served natural flows to adjust the internal state variables of a conceptual rainfall-runoff model to achieve agreement between observed and model flow. The overall procedure is accommodated flow. The overall procedure is accommodated within a decision support system for drought management that is implemented on a microcomputer and makes extensive use of interactive menus, forms and color graphic displays. A key feature of the system is the maintenance of an up-to-date archive of hydrometric data which is achieved through a real-time communication link with a second computer dedicated to real-time data acquisition via telemetry. Monitoring the reliability of sition via telemetry. Monitoring the reliability of the water resource system during droughts is made a quick and easy task, and the effect of a change in a quick and easy task, and the effect of a change in the operating policy on system reliability can be readily assessed. The information obtained pro-vides valuable support for tactical decision-making within the overall long-term operating strategy. (Author's abstract) W90-07026

HYDRAULIC RESISTANCES OF DEFORMA-BLE CHANNELS AND THEIR STABILITY

For primary bibliographic entry see Field 8B. W90-07048

SEASONAL VARIATION OF CERTAIN OXI-DATION-REDUCTION CHARACTERISTICS OF THE RIVER BHAGIRATHI (INDIA). Garhwal Univ., Srinagar (India). Dept. of Zoolo-

gy. For primary bibliographic entry see Field 5B. W90-07058

FLOW NEAR SLOPED BANK IN CURVED CHANNEL.

Alberta Univ., Edmonton. Dept. of Civil Engi-

F. E. Hicks, Y. C. Jin, and P. M. Steffler. Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 1, p 55-70, January 1990. 14 fig, 1 tab, 15 ref.

Descriptors: *Channel flow, *Channel morphology, *Flow characteristics, *Flow velocity, *Fluid mechanics, *Hydraulics, *Shear drag, *Streamflow, Downstream, Flow pattern, Hydraulic properties, Turbulent flow, Upstream.

Shear and velocity distributions near a sloped bank in a 270 degree open channel bend were studied. Data, which included detailed velocity and turbulence measurements in both the longitudinal and transverse flow directions, were collected with a laser Doppler anemometer system. The flow adja-cent to a 2:1 (horizontal:vertical) and a 3:1 sloped cent to a 2:1 (horizontal-vertical) and a 3:1 sloped bank were examined to determine, in unprecedent-detail, the developing flow near a sloped bank in a curved channel, including the effect of varying side slope. It was found that the longitudinal flow redistribution is fully developed at the downstream end of this 270 degree bend, although the spiral flow is found to develop much more quickly. In the straight reach upstream of the bend, it was found that the friction factor on the sloped bank is more dependent on channel shape than a local velocity-shear-stress relationship. Within the bend, velocities and shear stresses on the sloped bank increase significantly, with the shear stress correlating more directly with the local velocity. (Author's abstract) W90-07067

2-D DEPTH-AVERAGED FLOW COMPUTA-TION NEAR GROYNE.

Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering. For primary bibliographic entry see Field 8B. W90-07068

TRANSMISSION LOSSES IN ARID REGION. Dames and Moore, Sarasota, FL. M. O. Walters.

Hydraulic Engineering (ASCE)

Field 2-WATER CYCLE

Group 2E-Streamflow and Runoff

JHEND8, Vol. 116, No. 1, p 129-138, January 1990, 2 fig. 3 tab. 12 ref.

Descriptors: *Arid lands, *Arid-zone hydrology, *Ephemeral streams, *Hydrographs, *Surface groundwater relations, *Tributaries, *Water loss, *Water shortage, Drought, Groundwater re-charge, Mathematical studies, Model studies, Saudi Arabia, Streamflow, Water scarcity.

Hydrographs of ephemeral streams in arid and semiarid regions usually decrease significantly in magnitude downstream, unless augmented by trib-utary flows. This process, termed transmission loss, utary flows. This process, termed transmission loss, is important not only in its obvious effect on flow reduction, but also as a source of groundwater recharge to underlying alluvial aquifers. Most of the previous work in transmission loss was carried out on the semiarid regions of the United States. Three regression equations were developed for relating transmission loss to channel characteristics relating transmission loss to channel characteristics for an arid region in southwest Saudi Arabia. One of the equations seems to be a reliable predictor of small losses associated with small upstream volumes. The other two equations were better predictors for large losses associated with large upstream volumes. Transmission loss data were also compared with some previously published. Although there was some scatter, the data was generally consistent with that previously published. (Author's abstract) thor's abstract)

SOIL MOISTURE AND THE PERSISTENCE OF NORTH AMERICAN DROUGHT. Yale Univ., New Haven, CT. Dept. of Geology

and Geophysics For primary bibliographic entry see Field 2G. W90-07076

EFFICIENT HORIZONTAL TWO-DIMEN-EFFICIENT HORIZONTAL TWO-DIMEN-SIONAL HYDRODYNAMIC MODEL. William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science. For primary bibliographic entry see Field 7C. W90-07093

NEED FOR COMPUTER-ASSISTED HYDROG-

E and S Computer Systems, Inc., Sparta, NJ. For primary bibliographic entry see Field 7C. W90-07103

CHANGES OF SOME PHYSICO-CHEMICAL AND SAPROBIOLOGIC CHARACTERISTICS IN THE LOWER COURSE OF THEISS IN THE

PERIOD 1980-1986. Novi Sad Univ. (Yugoslavia). Inst. of Biology. For primary bibliographic entry see Field 2H. W90-07111

PHOSPHATASE ACTIVITY OF WATER AS A PARAMETER OF THE RIVER TISA WATER MONITORING.

Novi Sad Univ. (Yugoslavia). Inst. of Biology. For primary bibliographic entry see Field 5A. W90-07112

DOMINANT BACTERIOFLORA IN THE WATER OF THE RIVER TISA AND THE MRTVA TISA (YUGOSLAVIA),
Novi Sad Univ. (Yugoslavia). Inst. of Biology. For primary bibliographic entry see Field 5A. W90-07113.

DEVELOPMENTS IN THE COMPOSITION OF BIOCENOSIS IN THE LOWER TISA RIVER (YUGOSLAVIA) CAUSED BY HYDROLOGICAL CHANGES.

Novi Sad Univ. (Yugoslavia). Inst. of Biology. For primary bibliographic entry see Field 2H. W90-07114

CHANGES IN THE QUALITY OF WATER IN LASKO STREAM AND THE STORAGE LAKE BUILT ON IT AT EGERSZALOK.

Heves County Service of Public Health and Epidemiology, Eger (Hungary).

For primary bibliographic entry see Field 5C.

W90-07118

COEXISTENCE OF TWO SPECIES OF SUCKER, CATOSTOMUS, IN SAGEHEN CREEK, CALIFORNIA, AND NOTES ON THEIR STATUS IN THE WESTERN LAHON-TAN BASIN.

California Univ., Berkeley. Dept. of Forestry and Resources Management.

I. M. Decker. Great Basin Naturalist GRBNAR, Vol. 49, No. 4, p 540-551, October 1989. 4 fig, 3 tab, 21 ref.

*California, *Nevada, *Species composition, *Stream fisheries, *Sucker, Adaptation, Aquatic habitats, Evolution, Fish management, Snorkel survey, Speciation.

The mountain sucker, Catostomus platyrhynchus, The mountain sucker, Catostomus platyrhynchus, and the Tahoe sucker, C. tahoensis, co-occur in Sagehen Creek and other streams in the Lahontan drainage basin of eastern California and west central Nevada. They are morphologically similar, and natural hybrids occur. The more widely distributed mountain sucker has been considered a product of Catostomus evolution, specialized for cool waters, rapid currents, and rocky substrates. The Tahoe sucker, endemic to the Lahontan Basin, is considered a stream generalist and reaches great est size and numbers in lakes and reservoirs. The observed distribution and relative abundance of the two Catostomus suckers have shifted dramatically over the past four decades in Sagehen Creek and nearby streams in eastern California. The mountain nearoy streams in eastern Camorina. The mountain sucker, formerly abundant and more numerous than the Tahoe sucker has become relatively rare and during this study was consistently less abun-dant than the Tahoe sucker at all eastern California sites in 1983. Similar shifts in abundance were not seen at the three Nevada sites. Behavioral observa-tions and data on spatial and temporal patterns of habitat use, collected in Sagehen Creek between May and September 1982 and 1983 using a snorkel May and September 1982 and 1983 using a shorket survey method, indicate nearly complete overlap between mountain and Tahoe sucker habitat use and an absence of any antagonistic behavioral interaction between species. The decline of the mountain sucker in these areas is likely the result of an interaction of loss of habitat due to reservoir construction and destructive management pracconstruction and destructive management practices. These changes may have led to the elimination of isolating mechanisms between the two species and may be increasing the opportunity for introgressive hybridization. (Mertz-PTT) W90-07141

ASSESSMENT OF SHORT-TERM DEPLETION OF STREAM MACROINVERTEBRATE BENTHOS BY DRIFT.
Pittsburgh Univ., PA. Dept. of Biological Sci-

For primary bibliographic entry see Field 2H. W90-07147

DIATOM SPECIES COMPOSITION ALONG A THERMAL GRADIENT IN THE PORTNEUF

RIVER, IDAHO, USA. Idaho State Univ., Pocatello. Dept. of Biology. For primary bibliographic entry see Field 2H.

FLUCTUATIONS IN THE COMMUNITY COM-POSITION OF WATER-COLUMN PROTOZOA IN TWO SOUTHEASTERN BLACKWATER

RIVERS (GEORGIA, USA).
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W90-07149

EFFECT OF LONG POOLS ON THE DRIFT OF MACRO-INVERTEBRATES IN A MOUNTAIN STREAM.

Montana State Univ., Bozeman. Dept. of Biology. For primary bibliographic entry see Field 2H. W90-07150

UPSTREAM-DOWNSTREAM MOVEMENTS OF AQUATIC INVERTEBRATES IN A ROCKY MOUNTAIN STREAM.

Colorado State Univ., Fort Collins. Dept. of Entomology. For primary bibliographic entry see Field 2H. W90-07151

MODELLING ECOLOGICAL IMPACTS OF THE ACIDIFICATION OF WELSH STREAMS: TEMPORAL CHANGES IN THE OCCUR-RENCE OF MACROFLORA AND MACROIN-VERTEBRATES.

University Coll., Cardiff (Wales). Dept. of Applied For primary bibliographic entry see Field 7C.

W90-07156

WINTER AND SPRING MACROINVERTE-BRATE DRIFT IN AN OUTPOCKETING OF THE LOWER MISSISSIPPI RIVER, LOUISI-ANA (USA).

Louisiana State Univ., Baton Rouge. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 2H.
W90-07158

EVALUATION OF THE EFFECT OF BANK STORAGE ON THE HYDROPOWER INDICES OF A HYDROELECTRIC STATION,

A. Y. Aleksandrovskii, G. F. Chernenko, and K. Litvin.

cal Construction HYCOAR, Vol. 23, No. 6, p 329-333, 1990. 2 fig, 2 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 23-26, June 1989.

Descriptors: *Bank storage, *Hydroelectric plants, *Model studies, *Reservoirs, *Surface runoff, *Surface-groundwater relations, Geohydrology, Rivers, Runoff.

In the practice of hydropower calculations the effect of the bank storage of surface runoff on the hydropower indices of a hydrostation has been insufficiently studied. One of the ways to increase the accuracy of evaluating hydropower indices is to improve the mathematical models of the hydrostation. The essence of the suggestion under consideration requires an increase in the number of river runoff factors in the water-balance equation. The hydrogeological river runoff factor called the bank hydrogeological river runoff factor called the bank storage represents the infiltration of river water into the banks during the rising stage of a flood and their return to the river during falling of the flood. For reservoirs with a long cycle of regulation this phenomenon is more characteristic and consider-able than for the channel part of a stream, since the time of water exchange of surface and subsurface waters increases during transformation of the river time of water exchange of surface and subsurface waters increases during transformation of the river runoff by a reservoir. Methods for evaluating the effect of bank storage are complex and laborintensive. Furthermore, they require a large amount of initial information or systematic on-site observations of the groundwater regime in the zone of reservoirs. The proposed approach to an evaluation of the effect of bank storage on hydropower indices of a hydrostation in the absence of detailed hydrogeological investigations of the territory directly adjacent to the reservoir, has sufficient accuracy and can be recommended for use at preliminary design stages. (Mertz-PTT)

KINEMATIC CHARACTERISTICS OF FLOWS IN TRANSITION SECTIONS OF UNLINED CANALS.

For primary bibliographic entry see Field 8B. W90-07174

WALLEYE SPAWNING HABITAT IN POOL 13 OF THE UPPER MISSISSIPPI RIVER. Iowa Dept. of Natural Resources, Bellevue. Belle-

vue Research Station. For primary bibliographic entry see Field 8I. W90-07180

Groundwater-Group 2F

RELATIONS OF PHYSICAL HABITAT TO ABUNDANCE OF FOUR NONGAME FISHES IN HIGH-PLAINS STREAMS: A TEST OF HABITAT SUITABILITY INDEX MODELS. Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie. For primary bibliographic entry see Field 8I. W90-07182

STUDY OF GROUNDWATERS USING THE ENVIRONMENTAL TRITIUM AND HYDRO-CHEMICAL DATA IN THE BELGRADE

Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2F.
W90-07188

NEW METHOD OF QUANTITATIVELY DE-SCRIBING DRAINAGE AREAS. Uppsala Univ. (Sweden). Dept. of Hydrology. For primary bibliographic entry see Field 7C.

LONG-TERM CHANGE IN THE SUITABILITY OF WELSH STREAMS FOR DIPPERS CIN-CLUS CINCLUS AS A RESULT OF ACIDIFICA-TION AND RECOVERY: A MODELLING

University Coll., Cardiff (Wales). School of Pure and Applied Biology. For primary bibliographic entry see Field 5C. W90-07194

STREAMFLOW CHARACTERISTICS OF SMALL WATERSHEDS IN THE BLUE MOUN-

SMALL WATERSHEDS IN THE BLUE MOUNTAINS OF OREGON.
Chequamegon National Forest, Park Falls, WI. D. A. Higgins, A. R. Tiedemann, T. M. Quigley, and D. B. Marx.
Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1131-1149, December 1989. 7 fig, 8 tab, 26 ref.

Descriptors: *Flow characteristics, *Grazing, *Land use, *Oregon, *Small watersheds, *Streamflow, Flood peak, Flow duration, Vegetation effects, Water yield.

Streamflow data for water years 1978-84 were evaluated to identify streamflow characteristics for 13 small watersheds (0.46-7.00 sq m) in the Blue Mountains of eastern Oregon and to determine differences among grazing intensities and vegetation types. The ranges for mean annual water yields, peaks flows, and 7-day low flows for the 13 watersheds were 5.5-28.1 inches, 2.0-34.7 cfsm, and 0.006-0.165 cfsm, respectively. Two classes of vegetation were evaluated: (1) western larch-Douglas fir (9 watersheds) and (2) other (4 watersheds representing fir-spruce, lodgepole pine, ponderosa pine, and mountain meadow). The means for annual peak flows and the slopes of the flow-duration curve were significantly different (p=0.05) for the two vegetation classes; differences in mean annual water yield were marginally (p=0.05) for the two vegetation classes; differences in mean annual water yield were marginally significant (0.05<p<0.10). After they were adjusted for precipitation, the means for annual water yield, peak flows, and slopes of the flow-duration curve were significantly different for the two vegetation classes; differences in the means for annual Advantage of the properties of the propert tation classes; differences in the means for annual 7-day low flows were marginally significant. The western larch-Douglas fir group had somewhat lower water yields but, overall, tended to have more favorable streamflow characteristics including lower peak flows, higher low flows, and more evenly distributed flow regimes (flatter flow-duration curves) than the 'other' class. Four levels of grazing intensity had no effect on streamflow characteristics. grazing intensity had no effect on streamflow characteristics. (Author's abstract) W90-07203

INCIDENCE OF FIN EROSION AND ANOMA-LOUS FISHES IN A POLLUTED STREAM AND A NEARBY CLEAN STREAM.

Ohio State Univ., Columbus. Environmental Biol-

ogy Program.
For primary bibliographic entry see Field 5C.
W90-07218

MODELLING WATER TEMPERATURE BE-NEATH RIVER ICE COVERS, National Hydrology Research Inst., Saskatoon

For primary bibliographic entry see Field 2H. W90-07235

SYSTEMATIC PROCEDURE FOR EVALUATING PARTIAL AREAS OF WATERSHED RUNOFF,

Griffith Univ., Nathan (Australia). School of Aus-

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.

W. C. Boughton.

Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 83-98, January/February 1990. 1 fig, 7 tab, 9 ref.

Descriptors: *Australia, *Catchment areas, *Mathematical analysis, *Rainfall-runoff relationships, *Runoff, Long-term studies, Source areas, Storage

A method was developed by which the propor-tions of a watershed that contribute surface runoff in different storms and at different times during the same storm can be determined by analysis of rainfall and runoff records. The method is a modificarail and runoit records. In method is a modifica-tion of a previously published method that elimi-nates the need for subjective selection of a particu-lar runoff for analysis. The method was applied to data from a 16.8-he watershed in Queensland, Aus-tralia, and the estimates of runoff from the different tralia, and the estimates of runoff from the different source areas were compared with actual records of runoff from the whole watershed. Runoff occurred from the entire watershed area on only three occa-sions for the 15-yr study period, about 10% of the runoff events. In about two-thirds of the runoff events, runoff came only from the 15% of the watershed that has the smallest surface storage capacity. (Author's abstract) W90-07321

WATER MANAGEMENT AND ECOLOGICAL PERSPECTIVES OF THE UPPER RHINE'S FLOODPLAINS.

Institute for Floodplains Ecology, Rastatt (Germa-For primary bibliographic entry see Field 6F. W90-07331

RIVER ENGINEERING IN NATIONAL PARKS: THE CASE OF THE RIVER WHARFE, U.K. University of East Anglia, Norwich (England). School of Environmental Sciences.

For primary bibliographic entry see Field 4A. W90-07333

RESTORATION AND ENHANCEMENT OF ENGINEERED RIVER CHANNELS; SOME EU-ROPEAN EXPERIENCES.

Water Authority, Reading (England). Rivers Div.

For primary bibliographic entry see Field 4A. W90-07334

DISTRIBUTION AND MOBILIZATION OF AR-SENIC AND ANTIMONY SPECIES IN THE COEUR D'ALENE RIVER, IDAHO.

Idaho Univ., Moscow. Dept. of Chemistry. For primary bibliographic entry see Field 5B. W90-07367

RATIONAL APPROACH TO THE ASSESS-MENT OF ALUMINIUM SOLUBILITY CON-

TROLS IN FRESHWATERS.
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W90-07391

FREEZE-CORING TECHNIQUE APPLIED TO POLLUTION BY FINE SEDIMENTS IN POLLUTION BY FINE GRAVEL-BED RIVERS.

Loughborough Univ. of Technology (England). Dept. of Geography.
For primary bibliographic entry see Field 5A.
W90-07399

SEASONAL VARIATIONS OF THE DEUTERI-UM CONTENT IN THE PARANA AND LIMAY RIVERS.

Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Quimica Analitica. For primary bibliographic entry see Field 2K. W90-07420

RESULTS OF BIOLOGICAL INVESTIGA-TIONS FROM THE LOWER VIRGIN RIVER VEGETATION MANAGEMENT STUDY. Bureau of Reclamation, Boulder City, NV. Lower

Colorado Region. For primary bibliographic entry see Field 4D. W90-07481

2F. Groundwater

IN-SITU EXPERIMENTS ON CHANGES OF SOLID HEAVY METAL PHASES IN AEROBIC AND ANAEROBIC GROUNDWATER AQUIFERS.

Fr.). Arbeitsbereich Umweltschutztechnik. For primary bibliographic entry see Field 5B. W90-06624

PROBLEMS AND METHODS INVOLVED IN RELATING LAND USE TO GROUND-WATER

QUALITY.
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 5B.
W90-06817

MANAGEMENT AND POLICY EFFECTS ON POTENTIAL GROUNDWATER CONTAMINATION FROM DAIRY WASTE,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 5G. W90-06819

RISK ANALYSIS ON AIR EMISSIONS FROM GROUNDWATER AERATION. Midwest Research Inst., Cary, NC. For primary bibliographic entry see Field 5F. W90-06834

ANALYSIS OF ONE-DIMENSIONAL SOLUTE TRANSPORT THROUGH POROUS MEDIA WITH SPATIALLY VARIABLE RETARDA-

WITH SPATIALLY VARIABLE RETARDA-TION FACTOR. Stanford Univ., CA. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W90-06852

MODELING FRACTURE FLOW WITH A STO-CHASTIC DISCRETE FRACTURE NETWORK: CALIBRATION AND VALIDATION: 1. THE

FLOW MODEL. Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). M. C. Cacas, E. Ledoux, G. de Marsily, B. Tillie,

and A. Barbreau.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 479-489, March 1990. 12 fig, 1 tab, 39 ref.

Descriptors: *Fracture flow, *France, *Geologic fractures, *Groundwater movement, *Model studies, *Radioactive waste disposal, *Stochastic models, Groundwater pollution, Path of pollutants, Radioactive wastes.

A large-scale investigation of fracture flow was recently conducted in a granite uranium mine at Fanay-Augeres, France. Its aim was to develop a Fanay-Augeres, France. Its aim was to develop a methodology for the investigation of possible nuclear waste repository sites in crystalline environments, and thus to determine what measurements to make and what models to use in order to predict the flow and transport properties of the medium, i.e., their average behaviors and spatial variabilities at different scales. Four types of data were collected (:1) geometry of the fracture network; (2) local hydraulic properties measured by injection tests in

Field 2-WATER CYCLE

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boreholes; (3) global hydraulic behavior from flow correnoies; (3) glooal hydraulic behavior from flow rate and piezometric head distribution at the mil-lion-square-meter scale; and (4) tracer tests per-formed at a scale of up to 40 m. The stochastic discrete fracture network model developed in this study assumes that fractures can be represented as circular discs, the density, orientation and size of which can be inferred from in situ geometric ob-servations. However, the flow in this model is assumed to be restricted to idealized channels within the fracture planes, the hydraulic conductrivities of which must be inferred from hydraulic tests. The parameters of a probability distribution function of the hydraulic properties of these chan-nels can be inferred from local scale hydraulic injection tests in boreholes, using the ergodic argument. A first validation of both the model structure and its calibrated parameters was obtained by sucand its calibrated parameters was obtained by suc-cessfully predicting the global-scale hydraulic con-ductivity of the system, determined in situ by global flow measurements. (See also W90-06858) (Author's abstract) W90-06857

MODELING FRACTURE FLOW WITH A STO-CHASTIC DISCRETE FRACTURE NETWORK CALIBRATION AND VALIDATION: 2. THE TRANSPORT MODEL.

Ecole Nationale Superieure des Mines de Paris,

Fontainebleau (France).

M. C. Cacas, E. Ledoux, G. de Marsily, A

Barbreau, and P. Calmels.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 491-500, March 1990. 14 fig, 1 tab, 18 ref.

Descriptors: *Fracture flow, *Geologic fractures, *Groundwater movement, *Model studies, *Radioactive waste disposal, *Stochastic models, France, Groundwater pollution, Path of pollutants, Radioactive wastes.

As part of the development of a methodology for investigating flow and transport in fractured rocks, a large-scale experiment was recently performed at a large-scale experiment was recently performed at a large-scale experiment was calibrated using in-situ tracer tests. Microscopic dispersion in the fractures and retardation effects due to unevenness of the flow paths were taken into account. The model is capable of predicting into account. The model is capable of predicting both the regional flow properties of the medium and its variability at any scale starting from that of a single fracture. The dispersive properties of the model were reasonably comparable to those of the real site. The validity of the preliminary hydraulic calibration of the model was confirmed and the approach used to simulate hydraulic and transport phenomena was thus validated. (See also W90-06857) (Author's abstract)

DIRECT AND BOUNDARY-ONLY SOLU-TIONS OF MULTILAYER AQUIFER SYS-TEMS: PART A. STEADY STATE-SOLUTION. Georgia Inst. of Tech., Atlanta. School of Civil

Georgia ins. Accept the Engineering. M. Zakikhani, and M. M. Aral. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 49-67, November 1989. 9 fig, 25 ref.

Descriptors: *Aquifers, *Boundary integral element method, *Flow equations, *Groundwater movement, *Mathematical models, *Model studies, *Multilayer aquifers, *Steady flow, Model testing, Numerical models, Pumping, Wells.

In recent years, the boundary integral element method (BIEM) has been widely used in the area of groundwater modeling. This method, which is based on Green's theorem, has a variety of advantages over domain methods. Early applications of the BIEM to multilayer aquifer problems were made using iterative procedures. Iterative methods usually are slower than the direct solutions and are ground to errors due to their biased convergence. prone to errors due to their biased convergence prone to errors aue to their bases convergence criteria definitions. In the study presented here, a noniterative boundary integral equation formulation (NBIEM) for multilayer aquifer systems is developed. Further, this formulation is combined with the secondary reduction boundary element formulation (SR-BEM) to reduce the computation to a boundary-only form. The accuracy of the

proposed procedure was verified with application of the computer program to classical homogeneous groundwater problems, where analytical or finite element solutions can be defined. In this analysis it was observed that numerical error was mainly a function of order of Gaussian quadrature techniques used and the idealization of the region. For accurate solutions, high-order Gaussian quadra-tures and smaller elements are needed near the well as expected. In this application, four-point Gaussian quadratures are used for domain integrals Gaussian quadratures are used for boundary and two-point Gaussian quadratures are used for boundary integral evaluations in all applications. For a domain with a point source or sink (e.g., pumping or recharge well), a mesh system that consists of symmetric and finer elements around the well, is recommended. For the SR-BEM, the the well, is recommended. For the SR-BEM, the locations and the number of internal points play a major role in the accuracy of the results. In applying the SR-BEM to radial problems such as those presented here, radially located internal points improve the accuracy considerably. The nodal arrangement for NIBEM has to be such that internal nodes do not coincide with the well locations, whereas for SR-BEM this is not necessary since such nodes can be eliminated. (See also W90-0687) (Rochester-PTT) W90-06886

DIRECT AND BOUNDARY-ONLY SOLU-TIONS OF MULTILAYER AQUIFER SYS-TEMS: PART B. UNSTEADY-STATE SOLU-TION

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. Zakikhani, and M. M. Aral.

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 69-87, November 1989. 5 fig, 22 ref.

Descriptors: *Aquifers, *Flow equations, *Groundwater movement, *Mathematical models, *Model studies, *Multilayer aquifers, *Unsteady flow, Algorithms, Aquitards, Numerical models, Porous media, Secondary reduction boundary ele-

In a previous paper, direct boundary integral for-mulation of steady-state groundwater flow equa-tions in multilayer aquifer systems were described in which the solution can be reduced, if desired, to a boundary-only form using the secondary reduc-tion boundary element formulation. The present contribution extends this formulation to unsteady problems in multilayered aquifer systems. In this approach unsteady flow equations in aquifers acolved analytically, including aquifer storage. These analytical solutions then are coupled with These analytical solutions then are coupled with numerical algorithms in main aquifers to yield pro-cedures for time-dependent simulation of multilay-er aquifer systems. The proposed procedure can be used for computation of the piezometric head within the multilayer domain or the computation may be reduced to boundary-only form if desired. may be reduced to boundary-only form it desired. Using the natural log function rather than the Bessel function in this formulation yielded more accurate and stable results in all applications. The temporal terms in the governing equation are eval-uated by the use of a finite difference formulation that improves the efficiency of the computation. Application of the proposed formulation to classic porous media problems demonstrated the reliability and accuracy of the method. Although only two-layer problems are considered, the formula-tion may be used for N-layer aquifer-aquitard sys-tems. (See also W90-06886) (Rochester-PTT)

OPTIMIZATION MODEL FOR UNCONFINED STRATIFIED AQUIFER SYSTEMS.

Utah Water Research Lab., Logan. U. Lall, and M. D. Santini.

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 145-162, November 1989, 3 fig, 4 tab, 17 ref. DOI Contract 14-08-0001-1072.

Descriptors: *Groundwater management, *Groundwater movement, *Mathematical analysis, *Model studies, *Unconfined aquifers, *Water yield, Cost analysis, Mathematical models, Optimization, Stratification

A response matrix formulation is presented for optimal groundwater management where the aquifer system is unconfined and stratified (layered). While such formulations are easy to develop for the case of a confined aquifer with a linear partial the case of a continea aquiter with a linear partial differential equation governing flow, they can be difficult for unconfined aquifer systems. The concept of the Girinski potential is shown to be useful for the development of a linear approximation to the equation for flow in an unconfined, stratified the equation for flow in an unconfined, stratified aquifer system. The use of superposition (implicit in the response matrix approach) with the Girinski potential for a unconfined, stratified aquifer system is strictly valid for steady-state flow conditions. Linear superposition of Girinski potentials in the transient case is valid, subject only to a restriction determined by the relative hydraulic conductivities and thickness of each layer in the strata, and the and thickness of each layer in the strata, and the head of the aquifer. For a given situation, the limiting value of the head in the aquifer that restricts the application of superposition with the Girinski potential can be evaluated prior to the applications involving minimum pumping, minimum pumping cost, and minimum pumping and well installation cost for pumped aquifer dewatering, it was observed that, if high drawdowns are desired and well canacities are limited, three differdesired and well capacities are limited, three differ-ent optimization formulations give the similar re-sults. However, if these factors are not limiting and suits. However, if these factors are not limiting and amortized well installation costs are significant relative to pumping costs, the commonly used surrogate formulations of minimum pumping and minimum pumping costs lead to solutions that may be far from optimal in terms of system cost. (Rochester-PTT) W90-06891

SURFACE GEOELECTRICS FOR THE STUDY OF GROUNDWATER POLLUTION: SURVEY

Geofyzika N.E., Geologicka, Barrandov (Czechoslovakia). For primary bibliographic entry see Field 7A. W90-06892

OPTIMAL PUMPING POLICY AND GROUND-WATER BALANCE FOR THE BLUE LAKE AQ-UIFER, CALIFORNIA, INVOLVING NONLIN-EAR GROUNDWATER HYDRAULICS.

Indian Inst. of Tech., Bombay. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W90-06893

SPATIAL VARIABILITY OF GROUNDWATER RECHARGE IN A SEMIARID REGION. Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of

Organization, Oren Osmond (Austrana). Div. of Water Resources. P. G. Cook, G. R. Walker, and I. D. Jolly. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 195-212, November 1989. 9 fig. 1 tab, 35 ref. Australian Water Advisory Council Grant 85/135.

Descriptors: *Arid lands, *Australia, *Geophysical exploration, *Groundwater recharge, *Recharge, *Saline groundwater, Chlorides, Electrical studies, Hydraulic conductivity, Infiltration rate, Network design, Prediction, Salinity, Sampling, Spatial variation, Statistics.

Chloride profiles and electromagnetic techniques Chloride profiles and electromagnetic techniques were used to estimate rates of groundwater recharge in the Western Murray Basin, southern Australia. The use of electromagnetic techniques allowed large numbers of estimates to be made in a relatively short period of time, thus permitting statistical analysis of the spatial variability. Recharge rates appear to be approximately log-normally distributed, in accordance with published results of infiltration rate and hydraulic conductivity. The spatial structure is defined approximately. ty. The spatial structure is defined approximately by a spherical semivariogram. The results derived oy a spherical semivariogram. The results derived were applied to a study of groundwater saliniza-tion. Based on the estimated recharge distribution, predictions of future recharge and salt loads to the aquifer were made. The increase in groundwater salinity resulting from the flux of salt to the water

Groundwater-Group 2F

table will depend on the rate of movement of the groundwater and the amount of mixing with deeper groundwaters. The importance of considering spatial variability in recharge studies can be seen by comparing mean recharge and salt fluxes to the groundwater predicted using areal averages with those predicted after considering spatial variability. Large spatial variability results in the effects of clearing beginning to be seen much sooner, due to the effect of the high-recharge sites, but with the full impact delayed, because of the low-recharge sites. Lower spatial variability results in a much more sudden impact. (Rochester-PTT) W90-06894 table will depend on the rate of movement of the

INTEGRAL METHOD SOLUTION FOR DIF-FUSION IN A SPHERICAL BLOCK.

Lawrence Berkeley Lab., CA. Earth Sciences Div. R. W. Zimmerman, and G. S. Bodvarsson. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 213-224, November 1989. 5 fig, 18 ref. DOE Contract DE-AC03-76SF00098.

Descriptors: *Diffusion, *Fracture permeability, *Groundwater movement, *Infiltration, *Porous media, Aquifers, Integral method, Mathematical analysis, Physics, Reservoirs.

An appropriate analytical solution is derived for the problem of a Newtonian fluid infiltrating into a porous spherical block. The fluid in the block is porous spherical block. The fluid in the block is initially at a constant pressure, while the pressure initially at a constant pressure, while the pressure at the outer boundary is held at a constant value. Using the simple assumption of linear pressure profiles, the instantaneous and cumulative fluxes into the sphere are predicted with surprisingly high accuracy. The solution applies to all other physical processes governed by the same equation, such as heat conduction and chemical diffusion. The solution should be very useful for incorpora-tion into double-porosity models for fractured res-ervoirs and aquifers. (Author's abstract) W90-06895

GROUNDWATER RECHARGE PROCESSES IN SEDIMENTARY STRUCTURES OF THE CZECH CRETACEOUS BASIN.

Stavebni Geologie, Prague (Czechoslovakia). J. Balek, and M. Bursik. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 225-234, November 1989. 6 fig, 4 tab, 10 ref.

Descriptors: *Czechoslovakia, *Geohydrology, *Groundwater recharge, *Hydrologic models, Aquifers, Experimental basins, Mathematical studies, Prediction, Regional planning, Sedimentary structures, Soil properties, Temporal distribution.

Intensive studies of the groundwater regime in the Czech Turonian formations were carried out in 1982-1987. In this area of about 15,000 sq km, 25 1962-1987. In this area of about 15,000 sq km, 25 conceptual models (one/subregion) were applied to determine the safe yield and its variability throughout the whole area. To assess model parameters, an intensive observation of groundwater regime and other components of the hydrologic regime and other components of the hydrologic balance were conducted at the Nedamov experi-mental basin. In-situ experiments were focused on the magnitude of the baseflow (considered identi-cal to the safe yield over the long term). A time delay of the baseflow with respect to the precipita-tion regime and significant spatial variability in tion regime and significant spatial variability in recharge were apparent. The hydrologic regime, particularly the baseflow, originates from three types of recharge processes. Entering water of recent origin is stored temporarily before it forms the baseflow. The time of delay does not exceed 6 yr, however, and may vary from place to place. Only a small part of the water contributes to baseflow formation immediately or after a short delay. A significant contribution is made by a separate exogenous system of horizontal fissures. A rather insignificant contribution can be expected from the Cenomanian aquifer along isolated verti-cal communications in the impermeable layer. Deep soils of aeolian origin are less favorable for local recharge, whereas shallow sandy profiles on fractured rock seem to form the majority of the contributing areas. (Rochester-PTT)

POTENTIAL USE OF DEEP AQUIFERS IN THE NEGEV DESERT, ISRAEL: A MATHE-MATICAL MODEL AND ITS NUMERICAL SO-

LUTION.
Hebrew Univ. of Jerusalem (Israel). Seagram

Centre for Soil and Water Sciences. R. Nativ, Y. Bachmat, and A. Dax. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 293-319, November 1989. 6 fig. 11 ref.

Descriptors: *Confined aquifers, *Groundwater movement, *Groundwater potential, *Hydrologic models, *Israel, *Mathematical models, *Water yield, Aquicludes, Groundwater management, Head, Mathematical equations, Negev Desert, Numerical analysis, Salinity, Temperature.

A mathematical model and its numerical solution A mathematical model and its numerical solution are presented for a hydraulic system consisting of two deep aquifers in the Negev Desert that are partially separated by an aquiclude. Groundwater is confined, except for small areas, and it is not homogenous because of large variations in salinity and temperature. The model is designed to predict aquifer response to pumpage in terms of water pressure and density. Increasing the rate of pumpage is likely to enlarge the unconfined area. The concentral model has been transferred to a three conceptual model has been transformed to a three-dimensional mathematical model. Two factors made it possible to reduce the mathematical to two made it possible to reduce the mathematical to two dimensions in each aquifer by averaging equations along the vertical: (1) little variation in state variables along the vertical plane and (2) the presence of hydrostatic distribution and pressure. Differential mass and volume balance equations were employed for which the averages of water density and pressure along the vertical and any given point were the dependent variables. The piezometric head at any geographical point, however, could be used as a means for distinguishing between confined and water-table conditions in the hydraulic system at the initial state and at various pumpage states. The transformation of these equations into finite differences results in a large system of nonlinstates. The transformation of these equations into finite differences results in a large system of nonlinear equations. The sparse structure of this system suggests the use of a succession-over-relaxation scheme. However, the presence of highly nonlinear terms in the difference equations introduces considerable difficulty in applying this method. A special linearization technique was designed to overcome this difficulty. Other features that complicate the solution process are that dynamic considerable discovers. overcome this unitedity. Other reatures that confined-unconfined nature of the aquifers and the irregular shape of the aquiclude. The validity of the model was tested and verified by a series of simple test cases and the model was used to study aquifer response to various pumpage conditions. (Author's abstract) W90-06900

SIMULTANEOUS WATER AND SOLUTE MOVEMENT THROUGH AN UNSATURATED SOIL FOLLOWING AN INCREASE IN RE-CHARGE.

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2G.
W90-06904

APPLICATION OF GENE PROBES TO THE DETECTION OF ENTEROVIRUSES IN GROUNDWATER.

Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5A.
W90-06927

HOW ALUMINUM LEVELS IN SUBSURFACE DRINKING WATER SUPPLIES IN CANADA CAN BE USED TO PREDICT POSSIBLE IMPACT BY ACIDIC DEPOSITION. Health and Welfare Canada, Ottawa (Ontario). Environmental Health Centre.

For primary bibliographic entry see Field 5B. W90-06935

FIELD HYDROGEOLOGY. North West Water Authority, Warrington (Eng-

land). Planning Dept.

R. Brassington.

Geological Society of London Professional Handbook. Halsted Press, New York, New York. 1988.

Descriptors: *Data acquisition, *Geohydrology, *Geologic control, *Groundwater movement, *Measuring instruments, Field tests, Flow profile Groundwater resources, Rainfall, Surface water.

This book is primarily intended to help graduate geologists undertake the basic fieldwork necessary to understand the geohydrology of an area. It is a to understand the geonydrology of an area. It is a field guide with an emphasis on the 'how to' as-pects. Geohydrology is not entirely a field-based branch of the geological sciences. Therefore, a certain amount of background theory and analyti-cal methods to explain why particular field meas-urements are required, and the importance of making them in a particular way, is included. Increasingly, electronic equipment collecting data in digital form, and computer-based methods for handling these data, are employed, but the value of the answers so obtained relies entirely upon the rel-evance of the information used, and this in turn relies upon a consideration of the fundamental geological controls on groundwater movement. This handbook is intended to be a ready reference to simple field techniques which will help secure a knowledge of the fundamental controls operating in an area, and which can be used as a basis from which more elaborate theories may be developed. The order in which topics are covered in the book The order in which topics are covered in the book is designed to take the reader logically through the steps involved in a groundwater investigation in an unknown area. Early chapters cover the choice of equipment, collation of the available information and planning a fieldwork program. Various field methods are then described, including the measurements of rainfall and surface water flow. Advice is ments of raintain and surface water flow. Advice is offered on carrying out a wide range of specific investigations to help place the earlier chapters in an everyday context. The final chapter provides suggestions on safe working practices. (Lantz-PTT) W90-06942

FIELD GUIDE TO WATER WELLS AND BOR-

Water Research Centre, Medmenham (England). For primary bibliographic entry see Field 8A. W90-06943

CORROSION MANAGEMENT IN WATER SUPPLY SYSTEMS.

W. H. Smith.

Van Nostrand Reinhold, New York, New York. 1989. 125 p.

Descriptors: *Contamination, *Corrosion, *Corrosion control, *Leakage, *Water conveyance, *Water supply, Maintenance, Pipelines, Storage tanks, Water storage, Wells.

Corrosion failures can permit the entry of contamination into otherwise safe water-containing structures, such as tanks, pipe, wells, and even water sources, including both surface storage reservoirs and underground aquifers. Such failures can also result in the escape of water from transmission or distribution piping, causing flooding and the accompanying threats to property and public safety. This book is designed to serve water system operators, engineers, managers, and superintendents who need day-to-day corrosion reference guidelines applicable to water system management. It covers plicable to water system management. It covers those subjects most likely to be encountered in any water supply system: soil and water corrosion, atmospheric corrosion, stray current corrosion, and chemical attack. Within these broad categories, many specific factors that may cause corro-sion damage are described. For new and replacement projects, corrosion prevention procedures through materials selection, proper design and installation procedures, and environmental control are discussed along with mitigation practices for existing facilities. (Lantz-PTT)

Field 2-WATER CYCLE

Group 2F-Groundwater

SUPERFUND RECORD OF DECISION: HAST-INGS GROUND WATER/COLORADO AVE.,

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field 5G. W90-06930

SUPERFUND RECORD OF DECISION: AR-KANSAS CITY DUMP, KS. Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field 3G. W90-06951

SUPERFUND RECORD OF DECISION: OAK GROVE LANDFILL, MN.

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field SG. W90-06952

SUPERFUND RECORD OF DECISION: LUDLOW SAND AND GRAVEL, NY. Environmental Protection Agency, Washington,

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field SG. W90-06953

SUPERFUND RECORD OF DECISION: NA-TIONAL STARCH, NC.

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field 5G. W90-06954

INTEGRATION OF SURFACE AND GROUND-WATER RESOURCES FOR THE DEVELOP-MENT OF HAMAD BASIN PROJECT.

Arab Center for the Studies of Arid Zones and Dry Lands, Damascus (Syria). For primary bibliographic entry see Field 4B. W90-06960

ASSESSMENT OF THE EFFECT OF URBAN DEVELOPMENT ON GROUNDWATER
LEVELS IN A CHALK AQUIFER.
University Coll., Cardiff (Wales). School of Engi-

For primary bibliographic entry see Field 4C. W90-06962

HYDROGEOCHEMICAL ASSESSMENT OF GROUNDWATER QUALITY IN PARTS OF THE NIGER DELTA, NIGERIA. Port Harcourt Univ. (Nigeria). P. A. Amadi, C. O. Ofoegbu, and T. Morrison. Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 3, p 195-202, November/ December 1989. 4 fig, 3 tab, 25 ref.

Descriptors: *Groundwater chemistry, *Ground-water data, *Groundwater quality, *Niger Delta, *Nigeria, *Water chemistry, *Water quality, Bicar-bonates, Calcium, Chlorides, Coastal aquifers, Geohydrology, Iron, Magnesium, Sodium, Sul-

Detailed hydrogeochemical analysis of several samples of groundwater collected from parts of the Niger Delta, Nigeria has been carried out in an effort to assess the quality of groundwater in the area. Results obtained showed the groundwater in the area to be enriched in Na(+), Ca(++), Mg(++), Cl(-), HCO3(-), and SO4(-). The concentration of these ions as well as such parameters as salinity, total hardness, and total dissolved solids are below the World Health Organization (WHO) standards for drinking water. The concentration of Ca(++) was found to be higher than Mg(++) except in some areas very close to the coast suggesting the encroachment of saltwater. The encroachment of saltwater is further indicated by the general increase in Cl(-) and a decreased in Detailed hydrogeochemical analysis of several general increase in Cl(-) and a decreased in HCO3(-) content towards the coast and NaCl ratios. On the basis of the present hydrogeochemi-

cal studies, five groundwater types have been recognized to occur in the area of study. These are (1) Sodium-Calcium-Magnesium-Bicarbonate type (Na-Ca-Mg-5HCO3), (2) Iron-Calcium-Bicarbonate type (Fe-Ca-4HCO3), (3) Sodium-Calcium-Magnesium-Sulfate type (Na-Ca-Mg-5/2SO4), (4) Iron-Chloride-Bicarbonate (Fe-Cl-HCO3), and (5) Magnesium-Chloride type (Mg-2Cl). The assemblage of groundwater types in the area shows that both compound and single groundwater types occur. The geochemical characteristics of the groundwaters are thought to be closely related to the peculiar geologic and hydrologic conditions that prevail in the Niger Delta area of Nigeria. (Author's abstract)

EVALUATION OF SPATIAL DISTRIBUTION OF HYDRAULIC CONDUCTIVITY USING EFFECTIVE POROSITY DATA.

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab. L. R. Ahuja, D. K. Cassel, R. R. Bruce, and B. B.

Soil Science SOSCAK, Vol. 148, No. 6, p 404-411, December 1989. 6 fig, 1 tab, 16 ref.

Descriptors: "Effective porosity, "Groundwater movement, "Hydraulic conductivity, "Mathemati-cal equations, "Saturated flow, "Soil physical properties, "Soil prorsity, "Soil saturation, "Spatial distribution, Kozeny-Carman equation, Soil types.

The use of spatial distribution of effective porosity to estimate the distribution of saturated hydraulic conductivity is evaluated on five new soils and on a combination of soils. The distribution of saturata combination of soils. The distribution of saturated hydraulic conductivity is related to effective porosity by a generalized Kozeny-Carman equation. This equation is then combined with scaling theory to derive the frequency distribution of saturated hydraulic conductivity scaling factors from effective porosity distribution. The results of fractile diagrams and variances show that the use of the generalized Kozeny-Carman equation, with expense to the second taken agual to A or S frive overall agree overall safes agual to A or S frive overall safes agual to a safes agual to the safes ponent taken equal to 4 or 5 gives, overall, good estimates of the distribution of saturated hydraulic estimates of the distribution of saturated hydraulic conductivity scaling factors from effective porosity measurements. The exponent factor of 4 is more generally applicable. The above method applies as well across soil types, i.e. when the data of different soils are combined. The empirical equation for combined soils may also be used directly to estimate saturated hydraulic conductivity over an area, as a first-order approximation. (Author's abstract) stract) W90-06983

OBSERVATIONS OF DELAYED GRAVITY RESPONSE IN PARTIALLY PENETRATING

WELLS. CH2M Hill, Inc., Tempe, AZ. P. Mock, and J. Merz. Ground Water GRWAAP, Vol. 28, No. 1, p 11-16, January/February 1990. 5 fig, 2 tab, 19 ref.

Descriptors: *Aquifer testing, *Drawdown, *Geo-hydrology, *Gravity groundwater, *Groundwater movement, *Hydraulic conductivity, *Partially penetrating wells, *Pumping tests, *Water table *Water table profiles, Graphical analysis, Ground-water, Groundwater recharge, Lithologic logs, Pump wells, Unconfined aquifers, Vertical flow, Water level, Water table wells.

A 72-hr aquifer test was conducted at the Sweet-water Recharge site in Tucson, AZ for the purpose of estimating aquifer parameters using an earlier graphical curve-matching technique. These param-eter estimates will be used to estimate the moveeter estimates will be used to estimate the move-ment of groundwater under seasonal recharge and recovery operations at the site. The lithology of the saturated sediments at the site appears to be relatively uniform and homogeneous from the water table at about 100 feet below land surface to about 600 feet below land surface. The aquifer base is a fine-grained unit which extends from 600 feet to an unknown depth below the site. Poorly sorted sandy gravels and gravelly sands are predominant above 600 feet. A well was pumped at an average rate of 2,020 gallons per minute for 72 hr. Draw-

down and recovery measurements of water levels were made in five shallow monitoring wells and one deep monitoring well. The log-log drawdown versus time plots indicated delayed gravity response. The graphical curve-matching method was used to estimate aquifer parameters from the test results. Because the pumped and monitoring wells were characterized by varying degrees of partial penetration, the computer program DELAY2 was used to generate type curves for the unique arangement of wells at the site. Based on the testing conducted thus far, the aquifer was interpreted to respond to pumping as a homogeneous, vertically anisotropic water-table aquifer in which the vertical hydraulic conductivity is much less than the horizontal hydraulic conductivity and elastic storage affects aquifer response. Groundwater moves preferentially in the horizontal direction at this site, and vertical gradients become significant in preferentially in the horizontal direction at this site, and vertical gradients become significant in response to stresses in discrete vertical intervals. This evaluation is thought of the reliable at the spatial and time scale at which the aquifer has been tested. The horizontal hydraulic conductivity of the addirect tested at the site time section to the tested. The horizontal hydraline conductivity of the sediments tested at the site was estimated to be of the order of 320 gpd/sq ft. The vertical hydraulic conductivity of the sediments tested was estimated to be of the order of 5 gpd/sq ft. (Author's abstract) W9C-07010

EXTRACTION OF TCE-CONTAMINATED GROUND WATER BY SUBSURFACE DRAINS AND A PUMPING WELL.

EBASCO Services, Inc., Chicago, IL.
For primary bibliographic entry see Field 5G.
W90-07011

LABORATORY AND NUMERICAL INVESTI-GATION OF SOLUTE TRANSPORT IN DIS-CONTINUOUS FRACTURE SYSTEMS.

Newfoundland Dept. of Environment and Lands, St. John's. For primary bibliographic entry see Field 5B. W90-07012

SIMULATED EFFECTS OF QUARRY DEWA-TERING NEAR A MUNICIPAL WELL FIELD.

Geological Survey, Columbus, OH. S. M. Eberts, and E. S. Bair. Ground Water GRWAAP, Vol. 28, No. 1, p 37-47, January/February 1990. 9 fig, 2 tab, 14 ref.

Descriptors: *Dewatering, *Geohydrology, *Groundwater movement, *Groundwater pollution, *Leaching, *Municipal water, *Path of pollutants, Hydrologic models, Infiltration, Landfills, Leachates, Quarries, Simulation, Water level, Water rollution sources. Leachates, Quarries, S Water pollution sources.

The City of Columbus, OH obtains nearly 15% of its municipal water supply from four radial-collector wells located along the Scioto River and Big Walnut Creek. Upstream from the three wells located adjacent to the Scioto River are five uncontrolled landfills and two aggregate mines that operate quarry-dewatering systems. Flow paths along which leachate could migrate from the landfills, under existing conditions and under various hypothetical conditions related to the cessation of quarry dewatering, were simulated with a two-layer, steady-state, groundwater flow model incorporating spatially variable recharge, transmissivity, and hydraulic conductivity. The model was calibrated with two sets of water-level data and with the results of a seepage study along the Scioto River and Scioto Big Run. Results of simulations indicate that water levels near the quarries and landfills will rise to an altitude sufficient to saturate some of the landfill wastes. Predicted flow directives the state of the supplementation of the landfill wastes. Predicted flow directions and the supplementation of the landfill wastes. Predicted flow directions and the supplementations of the landfill wastes. Predicted flow directions and the supplementations of the landfill wastes. Predicted flow directions and the supplementations of the landfill wastes. The City of Columbus, OH obtains nearly 15% of landfills will rise to an attitude sufficient to saturate some of the landfill wastes. Predicted flow directions associated with all the hypothetical conditions indicate that leachate migrating from the landfills will not discharge directly into the capture zones of the collector wells; rather, the leachate will be diverted into one or the other quarry-department systems and/or into the Spirite Programment of the spirite P dewatering systems and/or into the Scioto River. The model simulations also indicate that approximately 60% of the groundwater discharged within the study area is by quarry dewatering, and about 13% of the yield of the collector wells under

Groundwater-Group 2F

normal pumping rates is from induced stream infil-tration. (Author's abstract) W90-07013

VOLUME ESTIMATION OF LIGHT NONA-QUEOUS PHASE LIQUIDS IN POROUS MEDIA.

Kennedy/Jenks/Chilton, Inc., San Francisco, CA. For primary bibliographic entry see Field 5B. W90-07014

ESTIMATION OF FREE HYDROCARBON VOLUME FROM FLUID LEVELS IN MONI-

TORING WELLS.
Virginia Polytechnic Inst. and State Univ., Blacks-Virginia Polytechnic Inst. and State Univ., Blacks-burg. Center for Environmental and Hazardous Material Studies. For primary bibliographic entry see Field 5B. W90-07015

WELL-PURGING CRITERIA FOR SAMPLING PURGEABLE ORGANIC COMPOUNDS. Geological Survey, Trenton, NJ. For primary bibliographic entry see Field 5A. W90-07016

COMPATIBLE SINGLE-PHASE/TWO-PHASE NUMERICAL MODEL: 1, MODELING THE TRANSIENT SALT-WATER/FRESHWATER INTERFACE MOTION.

Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.

For primary bibliographic entry see Field 5B. W90-07017

EVALUATION OF METHODS FOR DETER-MINING THE VERTICAL DISTRIBUTION OF HYDRAULIC CONDUCTIVITY.

Nevada Univ. System, Reno. Desert Research Inst. For primary bibliographic entry see Field 7B. W90-07018

ANALYSIS OF AQUIFER TESTS CONDUCTED IN FRACTURED ROCK: A REVIEW OF THE PHYSICAL BACKGROUND AND THE DESIGN OF A COMPUTER PROGRAM FOR GENERATING TYPE CURVES.

National Water Research Inst., Burlington (Ontar-

K. S. Novakowski

Ground Water GRWAAP, Vol. 28, No. 1, p 99-107, January/February 1990. 4 fig, 25 ref, append.

Descriptors: *Aquifer testing, *Computer programs, *Fracture permeability, *Geohydrology, *Geologic fractures, *Groundwater movement, *Pumping tests, *Type curves, Aquifers, Boundary conditions, Computer models, Hydrologic models, Interstitial water, Pump wells, Test wells.

Assessing the hydrogeological character of fractured bedrock between two or more wells is usually accomplished through an analysis of the results of traditional pumping tests. Because these tests are subject to field boundary conditions that may be different from those conducted in porous media, alternative testing techniques or analytical methods are required. To provide an adaptable interpretive package for analyzing interwell hydraulic tests in fractured rock, a FORTRAN program was developed to generate type curves for pumping tests and pulse interference tests. A review of the physical conditions which most influence the results of these tests was conducted to provide the background for the development and use of the program. The analytical solutions included in the program consider inner boundary conditions such as wellbore storage, infinitesimally thin skin and finite-thickness skin. In addition, a solution is included to analyze results influenced by wellbore storage and infinitesimally thin skin at both the pumping and observation wells. The solutions are given in the Laplace domain and are numerically inverted to generate data for the type curves. The curves can be plotted using any standard plotting program, or they can be plotted manually. The Assessing the hydrogeological character of frac-tured bedrock between two or more wells is usual-

program is menu driven, easily adaptable to include additional solutions, and can be executed on a personal computer. (Author's abstract) W90-07019

AUTOMATED ANALYSIS OF PUMPING TESTS IN UNCONFINED AQUIFERS OF SEMI-INFINITE THICKNESS,

Kuwait Inst. for Scientific Research, Safat. Water Resources Div.

S. A. S. Sayed. Ground Water GRWAAP, Vol. 28, No. 1, p 108-112, January/February 1990. 2 fig, 19 ref, append.

Descriptors: *Aquifers, *Automation, *Computer programs, *Drawdown, *Mathematical analysis, *Pump wells, *Pumping tests, *Test wells, *Unsconfined aquifers, Hydraulic properties, Less squares method, Mathematical studies, Pakistan, Sentitivity analysis. sitivity analysis.

A mathematical procedure is presented for automated fitting of test data for pumping from an unconfined aquifer of semi-infinite thickness. The unconfined aquifer of semi-infinite thickness. The fitting is achieved by sensitivity analysis and the least-squares method. The early and late time data are fitted to previously established models. The procedure has been used successfully in analyzing data from an extensive pumping test in Indus Basin, Pakistan. The results for one observation well indicated a close match with the computed and observed drawdowns. The method can be very useful in the analysis of pumping tests in thick, partially penetrated aquifers of unknown thickness. Such aquifers are common in the Indo-Gangetic plains. (Friedmann-PTT)

SURVEY OF FARM WELLS FOR PESTICIDES, ONTARIO, CANADA, 1986 AND 1987. Ontario Ministry of Agriculture and Food, Guelph (Ontario). Agricultural Lab. Services Branch. For primary bibliographic entry see Field 5B. W90-07028

DETERMINATION OF IN SITU METAL PAR-TITIONING BETWEEN PARTICULATE MATTER AND GROUNDWATER. Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research. For primary bibliographic entry see Field 5B. W90-07051

TRANSMISSION LOSSES IN ARID REGION.

Dames and Moore, Sarasota, FL. For primary bibliographic entry see Field 2E. W90-07072

TRANSPORT OF NONSORBED CHEMICALS IN THE SUBSURFACE ENVIRONMENT: PROPOSED MODEL WITH EXPERIMENTAL VER-

Southern Univ., Baton Rouge, LA. Dept. of Civil

For primary bibliographic entry see Field 5B. W90-07108

EVALUATION OF THE EFFECT OF BANK STORAGE ON THE HYDROPOWER INDICES OF A HYDROELECTRIC STATION.

For primary bibliographic entry see Field 2E. W90-07168

INFLUENCE OF CONSTRUCTION ON HY-DROGEOLOGICAL AND ENVIRONMENTAL CONDITIONS IN THE KARST REGION, EAST-ERN HERZEGOVINA, YUGOSLAVIA. Karst Water Research Inst., Trebinje (Yugoslavia). For primary bibliographic entry see Field 6G. W90-07187

STUDY OF GROUNDWATERS USING THE ENVIRONMENTAL TRITIUM AND HYDRO-CHEMICAL DATA IN THE BELGRADE

Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia).

M. Hadzisehovic, M. Zupancic, N. Miljevic, D. Palogoric, and M. Komatina.

Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 1, p 13-29, January/February 1990. 16 fig, 4 tab, 5 ref.

Descriptors: "Groundwater movement, "Surface-groundwater relations, "Tritium, "Water chemis-try, "Yugoslavia, Belgrade, Conductivity, Danube River, Groundwater, Hardness, Ions, Piezometers, Ranney wells, Sava River, Surface water.

Ranney wells, Sava River, Surface water.

A study of tritium content and some physicochemical parameters was performed in order to investigate the interconnection between surface and atmospheric waters and underground waters in the Belgrade area. Samples of the precipitation at Zeleno Brodo-Eelgrade meteorological station, the Danube and the Sava river water, and underground water (Ranney wells and piezometers) were analyzed. The tritium content, the content of dissolved ions, total hardness, and electrical conductivity were measured. The tritium data show the existence of two water strata in the aquifer. The upper stratum (about 16 m thick) contains older water (mean monthly tritium concentration of 17 TU) and has weak interaction with the river and the precipitation. Below this lies the principal water bearing stratum, strongly connected with the river with the tritium concentration similar to that of surface water (mean monthly tritium concentration of 50 TU) and spreading out through the entire aquifer. The contribution of the Sava river water and the two water layers at the Ranney well are calculated starting with the hydrological aquifer model, which supposes that three water components are mixed in the pumped Ranney well water. According to calculation results using the tritium concentration and physicochemical characteristics as parameters, more than 70% of the water pumped by the Ranney well (in 1983) comes from the Sava with a time delay of less than 15 days. Properties of tritium distribution in precipitation, river waters, and underground water in the Belgrade region are established from the results of measurements of tritium concentrations in the period 1976-83. (Author's abstract)

LEAD AND CADMIUM ASSOCIATED WITH SALTWATER INTRUSION IN A NEW JERSEY AQUIFER SYSTEM.

Geological Survey, West Trenton, NJ. For primary bibliographic entry see Field 5B. W90-07216

SORPTION AND TRANSPORT OF PESTI-CIDES IN GROUND WATER: CRITICAL REVIEW.
Oklahoma Univ., Norman, School of Civil Engi-

neering and Environmental Science. For primary bibliographic entry see Field 5B. W90-07315

VALIDATING GLEAMS WITH FIELD DATA FOR FENAMIPHOS AND ITS METABOLITES. Agricultural Research Service, Tifton, GA. South-east Watershed Research Lab.

For primary bibliographic entry see Field 5B. W90-07317

ALDICARB IN VADOSE ZONE: REVIEW. Bureau of Reclamation, Denver, CO. Resource Suitability Branch. For primary bibliographic entry see Field 5B. W90-07318

PUMP TEST ANALYSIS OF CONFINED AQUI-

Roorkee Univ. (India). Dept. of Civil Engineering. P. K. Swamee, and C. S. P. Ojha.

Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 99-106, January/February 1990. 2 fig, 2 tab, 8 ref.

Field 2—WATER CYCLE

Group 2F-Groundwater

Descriptors: *Confined aquifers, *Mathematical analysis, *Pumping tests, Accuracy, Performance evaluation, Storage coefficient, Transmissivity, Well function.

The storage coefficient and transmissivity are important aquifer parameters that are useful in assessing the ground-water potential of an aquifer. For a portant aquifer parameters that are useful in assessing the ground-water potential of an aquifer. For a nonleaky confined aquifer, these parameters can be determined with the help of a pump test. The present practice of aquifer parameters determination uses approximations of well function valid for small arguments only. In the absence of a full-range equation for the well function, it is not possible to utilize the entire set of pump test data. A high-accuracy expression for the well function valid for the entire range of its argument has been developed. The present practice of parameter estimation uses least square method. This gives undue importance to large errors. A criteria function capable of ignoring large observational errors has been suggested to replace the least square method. Minimizing the cumulative criteria function, the aquifer parameters can be estimated with a high degree of accuracy. A criteria function capable of ignoring large observational errors also was developed. Minimizing the cumulative criteria function, aquifer parameters can be estimated with a high degree of accuracy. (Author's abstract)

FINITE DIFFERENCE SOLUTION OF BOUS-SINESQ UNSTEADY-STATE EQUATION FOR HIGHLY SLOPING LANDS.
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Irrigation

and Drainage Engineering.
K. N. Shukla, H. S. Chauhan, and V. K. Srivastava.

Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 107-113, January/February 1990. 1 fig, 1 tab, 12 ref.

Descriptors: *Boussinesq equation, *Groundwater movement, Comparison studies, Groundwater level, Mathematical equations, Performance evaluation, Slopes

Various analytical and numerical solutions are available for the steady-state form of Boussinesq's equation describing the phreatic surface on sloping lands. Except for a single set of published experilands. Except for a single set of published experimental results, no analytical or numerical solution is available for the unsteady-state drainage of highly sloping lands. A finite difference solution has been obtained for the nonlinear unsteady-state differential Boussinesq equation for drainage of sloping lands. Overall on the basis of a study of dimensionless heights and location of water table divide for various values of dimensionless times (tK/EL as given by finite difference solution), the musteady-state form of the Boussinesse countrion is unsteady-state form of the Boussinesq equation is able to characterize appropriately the phreatic surable to characterize appropriately the pinteatic surface and the location of highest point of water table only up to 30% slope. This is probably because the original Boussinesq equation is based on the Dupuit assumption in which streamlines are horizontal in slowly varying seepage. Beyond a particular slope, this assumption gets completely vitiated, which probably explains why the numerical solution does not give reasonable results. (Rochester-PTT) W90-07323

IMPACT OF CHANNELIZATION ON THE HY-DROLOGY OF THE UPPER RIVER MAIN, COUNTY ANTRIM, NORTHERN IRELAND: A LONG-TERM CASE STUDY.

Ulster Univ. at Jordanstown, Newtownabbey (Northern Ireland). Dept. of Computing Science. For primary bibliographic entry see Field 4A. W90-07332

SIMULATION OF BIODEGRADABLE ORGAN-IC CONTAMINANTS IN GROUNDWATER: 1. NUMERICAL FORMULATION OF PRINCI-PAL DIRECTIONS.

Waterloo Univ. (Ontario). Inst. for Ground Water Research

For primary bibliographic entry see Field 5B.

W90-07351

SIMULATION OF BIODEGRADABLE ORGANIC CONTAMINANTS IN GROUNDWATER: 2. PLUME BEHAVIOR IN UNIFORM AND RANDOM FLOW FIELDS.

Waterloo Univ. (Ontario). Inst. for Ground Water Research. For primary bibliographic entry see Field 5B. W90-07352

CONTINUOUS-TIME INVERSE OPERATOR FOR GROUNDWATER AND CONTAMINANT TRANSPORT MODELING: DETERMINISTIC

Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-07353

ABORATORY VERIFICATION OF THE RE-SIDUAL FLOW PROCEDURE FOR THREE-DI-MENSIONAL FREE SURFACE FLOW.

MENSIONAL PREE SURFACE FLOW. Fluor Daniel, Inc., Irvine, CA. B. Baseghi, and C. S. Desai. Water Resources Research WRERAQ, Vol. 26, No. 2, p259-272, February 1990. 18 fig, 2 tab.

*Free surfaces, *Groundwater movement, *Hydraulic models, Porous media, Dams, Wells, Aquifers, Numerical analysis.

Many practical situations in water resources engineering, such as flow through and in dams, wells, and aquifers, involve three-dimensional free surface seepage. With such complexities as nonhomogeneities in material properties and arbitrary geometries, it very often is difficult to develop closed-form analytical solutions for these problems. The residual flow procedure with the finite element method is presented for three-dimensional free surface flow. It was verified with respect to observations of transient free surface during rise observations of transient free surface during rise, steady state, and drawdown calculations in homogeneous and nonhomogenous glass bead models for dams. Particular attention was given to the for dams. Particular attention was given to the determination of material properties: permeability and specific storage. The numerical procedure was able to provide highly satisfactory back predictions of the observed flow behavior. (Rochester-PTT) W90-07355

VARIABLE-RATE PUMPING TESTS FOR RADIALLY SYMMETRIC NONUNIFORM AQUIFERS.

Kansas State Geological Survey, Lawrence For primary bibliographic entry see Field 7B. W90-07358

COLLOID MOBILIZATION IN TWO ATLAN-TIC COASTAL PLAIN AQUIFERS: FIELD STUDIES.

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. For primary bibliographic entry see Field 5B. W90-07359

COLD WATER INJECTION INTO SINGLE-AND TWO-PHASE GEOTHERMAL RESER-VOIRS.

S-Cubed, La Jolla, CA. S. K. Garg, and J. W. Pritchett. Water Resources Research WRERAQ, Vol. 26, No. 2, p 331-338, February 1990. 5 fig. 1 tab, 10

Descriptors: *Aquifer testing, *Geothermal water, *Groundwater movement, *Injection, *Model studies, *Pumping tests, Numerical analysis, Performance evaluation, Porous media, Pressure, Simulation, Temperature, Viscosity.

Approximate analytical solutions are derived for cold water injection into single-phase and two-phase 'porous medium' geothermal reservoirs. A numerical geothermal reservoir simulator is used to verify the applicability of the analytical solution for pressure transient analysis. In accordance with these numerical results the analytical solutions indicate that the pressure buildup behavior during injection into either a single-phase liquid or twophase reservoir is governed by the kinematic vis-cosity of the cold injected fluid. The falloff prescostry of the cold injected fund. The failoff pre-sures after cold water injection into a single-phase liquid reservoir (except for very early shut-in times) are controlled primarily by the kinematic viscosity of the in situ (hot) reservoir fluid. For two-phase reservoirs, however, the falloff behavior two-phase reservoirs, however, the rainth behavior is considerably more complex and cannot be described fully by the analytical solution developed herein. (Author's abstract)
W90-07361

FIRST- AND THIRD-TYPE BOUNDARY CONDITIONS IN TWO-DIMENSIONAL SOLUTE TRANSPORT MODELING.

International Technology Corp., Monroeville, PA. For primary bibliographic entry see Field 5B. W90-07362

NEW COUPLING TERM FOR DUAL-POROSITY MODELS.

Sandia National Labs., Albuquerque, NM. Fluid and Thermal Sciences Dept. R. C. Dykhuizen.

Water Resources Research WRERAQ, Vol. 26, No. 2, p 351-356, February 1990. 3 fig. 1 tab, 23 ref. DOE Contract DE-AC04-76DP00789.

Descriptors: *Dual-porosity models, *Groundwater movement, *Model studies, *Porous media, Concentration, Heat flow, Mathematical models, Numerical analysis, Performance evaluation, Pressure, Solute transport, Temperature.

Numerous models are available for simulating dual-porosity flow of groundwater, heat, or solute in a fractured porous medium. Each approach inin a tractured porous medium. Each approach involves various approximations and results in models of varying complexity. One of the simplest models was proposed by Barenblatt and others in 1960 and Warren and Root in 1963. It assumes that the flow exchange (of fluid, heat, or solute) between the two porosity systems can be written as a linear function of the difference between averaged driving potentials (pressure, temperature, or con-centration). This has been called the quasi-static formulation because it can be shown to be correct only for long dimensionless time. A new formulaonly for long dimensionless time. A new formula-tion of this model is proposed here that retains the original simplicity but is not restricted to very slow transient flows. The integral method was used to derive the coupling term for the early parts of the transient regime. While the quasi-steady approxi-mation is eliminated in deriving the coupling term, the only extra calculation is a choice in the cou-pling term based on a switchover relation. The model can be used for the transport of fluid, heat, or solute by simply switching the potential used in the formulation. The new coupling term is nonlin-ear, which makes the solution somewhat more ear, which makes the solution somewhat more difficult than the quasi-steady model (which is linear), but numerical solutions usually are used. (Author's abstract) W90-07363

PROPERTIES OF FULVIC ACIDS FROM DEEP GROUNDWATERS.

Linkoeping Univ. (Sweden). Dept. of Water and Environmental Research. C. Pettersson, I. Arsenie, J. Ephraim, H. Boren,

and B. Allard. Science of the Total Environment STENDL, Vol. 81/82, p 287-296, June 1989. 2 fig, 2 tab, 13 ref.

Descriptors: *Fulvic acids, *Groundwater dating, *Humic substances, *Organic matter, *Water chemistry, Acidity, Carbonates, Chemical properties, Degradation

Fulvic acids were recovered from three deep groundwaters and one surface water and characterized with respect to elemental composition, mo-lecular weight, acid capacity and Cl4-age. The corresponding waters were also characterized in detail. All of the fulvic acids, with ages varying

Water In Soils—Group 2G

from 0 to 5250 years, were very similar in chemical composition and acidity. The only significant dif-ference between fresh and old materials was lower content of oxygen and nitrogen and higher COOH/OH-ratios for the materials from the old waters. The high resistance to degradation of the humic substances in groundwater, as well as the expected low interactions between humic subexpected low interactions between numic sub-stances and geologic matter would make the humic substances excellent indicators of groundwater age and probably more suitable than the inorganic car-bonates for this purpose. (Geiger-PTT)

GROUNDWATER POLLUTION BY MANGA-NESE: MANGANESE SPECIATION-APPLICA-TION TO THE SELECTION AND DISCUSSION OF AN IN SITU GROUNDWATER TREAT-

Aix-Marseille-1 Univ. (France). Lab. Chimie et

Environnement.
For primary bibliographic entry see Field 5B.
W90-07396

MUTAGENIC ACTIVITY IN GROUNDWATER IN RELATION TO MOBILIZATION OF ORGANIC MUTAGENS IN SOIL.

GANIC MUTAGENS IN SOIL.
Stichting Waterlaboratorium Oost, Doetinchem (Netherlands).
For primary bibliographic entry see Field 5C.
W90-07397

SPECIATION OF IONIC ALKYLLEAD IN POTABLE WATER AND SOIL.
Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

istry.

For primary bibliographic entry see Field 5B. W90-07398

BIOREMEDIATION OF CHLOROPHENOL CONTAINING SIMULATED GROUND WATER BY IMMOBILIZED BACTERIA.

Alko Ltd., Helsinki (Finland).
For primary bibliographic entry see Field 5G.
W90-07429

DRUM CENTRIFUGATION MODELLING OF LONG TERM POLLUTANT MIGRATION THROUGH A SOIL LAYER,

Cambridge Univ. (England). Dept. of Engineering. For primary bibliographic entry see Field 5B. W90-07465

MOBILITY OF COLLOIDAL PARTICLES IN THE SUBSURFACE: CHEMISTRY AND HY-DROLOGY OF COLLOID-AQUIFER INTER-

Oak Ridge National Lab., TN. Environmental Sciences Div.

For primary bibliographic entry see Field 5B. W90-07482

RECHARGE STUDIES IN THE WESTERN MURRAY BASIN: 4. RESULTS OF A DRILL-ING PROGRAM AT KULKAMI.
Commonwealth Scientific and Industrial Research

Organization, Wembley (Australia). Div. of Water

Resources.
I. D. Jolly, M. Trenordan, A. N. Holub, P. G.
Cook, and J. C. Dighton.
Technical Memorandum 90/3, January 1990. 64p,
27 fig. 27 tab, 5 ref.

Descriptors: *Australia, *Groundwater recharge, Jesciptors: "Australia, "Groundwater recharge, "Murray River Basin, "Saline groundwater, "Saline water intrusion, Aluminum, Calcium, Chlorides, Deuterium, Drilling samples, Dry farm-ing, Grazing, Iron, Magnesium, Particle size, Phos-phorus, Potassium, Sodium, Soil properties, Soil water, Sulfur, Vegetation effects.

This report presents the results of a drilling program carried out between July 1987 and April 1989 at a field site near Kulkami in the western Murray Basin, South Australia. The aim of the project was to determine the time lag between the

clearing of native mallee (Eucalyptus spp.) vegeta-tion and the commencement of the resultant rise in the underlying saline groundwater. The holes were located beneath mallee vegetation, and on land which had been cleared in the last 9 to 22 years, which had been cleared in the last 9 to 22 years, and has since been used for dryland cropping and grazing. The samples collected were selectively analyzed for water content, chloride concentration, matric and total suction, deuterium concentration, elemental potassium, phosphorus, sulfur, calcium, sodium, magnesium, aluminum, and iron concentrations, and particle size composition. (Author's abstract) thor's abstract)

SUBSURFACE SCIENCE PROGRAM. PROGRAM OVERVIEW AND SCOPE; OVERVIEW OF THE SCIENTIFIC SCOPE, GOALS AND RELEVANCE OF FUNDAMENTAL RESEARCH IN SUBSOILS, GROUNDWATER AND CHEMICAL CONTAMINATION SPONSORED BY THE U.S. DEPARTMENT OF ENERGY.

DEPARTMENT OF ENERGY, Washington DC Office of

Department of Energy, Washington, DC. Office of Energy Research Energy Research.
For primary bibliographic entry see Field 5B.
W90-07485

2G. Water In Soils

USE OF A THERMAL SCANNER IMAGE OF A WATER STRESSED CROP TO STUDY SOIL SPATIAL VARIABILITY.

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). R. C. G. Smith, S. A. Prathapar, H. D. Barrs, and P. Slavich.

Remote Sensing of the Environment RSEEA7, Vol. 29, No. 2, p 111-120, August 1989. 5 fig, 19

Descriptors: "Available water, "Cropland, "Data acquisition, "Remote sensing, "Soil water, "Water stress, Clay loam, Clays, Infrared imagery, Thermal radiation.

This study evaluated the use of radiative surface This study evaluated the use of radiative surface temperature from a water-stressed crop to indicate sources of variability in soil characteristics affecting the availability of soil water. Use was made of a thermal infrared image collected by aircraft near solar noon of a 45-ha water stressed wheat crop. The data was analyzed by the a theory of regionalized variables to determine whether variability in ized variables to determine whether variability in observed radiative surface temperature was random or spatially related. Radiative surface temperatures varied between 24-29 C and semivariance analysis revealed that the variations were random but structured. The analysis indicated that any two locations separated within the field by 400 or 700 m were spatially unrelated. Field observations found that, at about 700 m, the soil type changed from a more fertile Yooroobla clay soil to a less fertile Wilbriggie clay loam. At about 400 m, soil coring data indicated that the thickness of heavy clay at the surface declined from 3 to < 1 m. At a coring data indicated that the thickness of neavy clay at the surface declined from 3 to < 1 m. At a smaller distance, the semivariance analysis indicated microvariations, which field observations associated with either gilgais or laser leveling of the land surface. These soil variations were likely to have caused variations in soil water availability and the observed estatial variability in radiative. and the observed spatial variability in radiative surface temperature. Semivariance analysis was also successful in indicating the location of these sources of spatial soil variability. (Author's abstract) W90-06737

ESTIMATING TOTAL DAILY EVAPOTRAN-SPIRATION FROM REMOTE SURFACE TEM-PERATURE MEASUREMENTS. Pennsylvania State Univ., University Park. Dept.

of Meteorology.

For primary bibliographic entry see Field 2D.

INFILTRATION EVALUATION OF FOUR ME-CHANICAL RAINFALL SIMULATION TECH-NIQUES IN SIERRA NEVADA WATERSHEDS.

Nevada Univ., Reno. Dept. of Range, Wildlife and Forestry. For primary bibliographic entry see Field 7B. W90-06829

SOME GENERAL RESULTS ON THE SEEP-AGE EXCLUSION PROBLEM.

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia), Div. of Environmental Mechanics.

J. R. Philip.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 369-377, March 1990. 2 fig, 1 tab, 5 ref.

Descriptors: *Mathematical models, *Model studies, *Seepage, *Soil water, Groundwater, Unsaturated flow.

The problems of water exclusion from, or entry into, subterranean macropores, tunnels, and cavities from steady downward unsaturated seepage were previously solved for cavities of certain geometric shapes. Asymptotic roof-boundary-layer so-lutions have now been obtained for the quasilinear seepage exclusion problem for ellipsoidal cavities of arbitrary aspect ratio and arbitrary horizontal axial index. An equation was developed for the maximum dimensionless potential at the cavity wall. The equation includes as special cases previ-ous results for circular, elliptic, and parabolic cyl-inders and for spheres, spheroids, and paraboloids. The equation for elliptic discs includes as special cases previous results for strips and circular discs. The various results are relevant also to cavities with ellipsoidal and flat elliptic roofs but otherwise of arbitrary (though not too irregular) configura-tion. (Shidler-PTT) W90-06846

ADVECTIVE-DISPERSIVE TRANSPORT OF DENSE ORGANIC VAPORS IN THE UNSATURATED ZONE, 1. MODEL DEVELOPMENT. Waterloo Univ. (Ontario). Inst. for Ground Water Research

For primary bibliographic entry see Field 5B. W90-06847

ADVECTIVE-DISPERSIVE TRANSPORT OF DENSE ORGANIC VAPORS IN THE UNSATU-RATED ZONE, 2, SENSITIVITY ANALYSIS, Waterloo Univ. (Ontario). Inst. for Ground Water Research.

For primary bibliographic entry see Field 5B. W90-06848

EXACT INTEGRAL SOLUTIONS FOR TWO-PHASE FLOW.

Colorado State Univ., Fort Collins. Dept. of Agri-cultural and Chemical Engineering. For primary bibliographic entry see Field 5B. W90-06849

DIFFUSION AND CONSUMPTION OF METH-ANE IN AN UNSATURATED ZONE IN NORTH-CENTRAL ILLINOIS, U.S.A. Geological Survey, Denver, CO. For primary bibliographic entry see Field 5B. W90-06890

SIMULTANEOUS WATER AND SOLUTE MOVEMENT THROUGH AN UNSATURATED SOIL FOLLOWING AN INCREASE IN RE-CHARGE.

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of

I. D. Jolly, P. G. Cook, G. B. Allison, and M. W. Hughes.

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 391-396, November 1989. 2 fig, 19 ref. Australian Water Research Advisory Council Grants 85/135

Descriptors: *Australia, *Groundwater movement, *Infiltration, *Saline groundwater, *Soil water,

Field 2-WATER CYCLE

Group 2G-Water In Soils

*Solute transport, Eucalyptus trees, Land clearing, Pressure fronts, Salinity, Solute fronts, Vegetation.

A number of studies have dealt with the propaga-tion of pressure and solute fronts through soil after large increases in infiltration. The present work describes, possibly for the first time, the movement of pressure and solute fronts in response to long-term hydrologic changes induced by modifications in land use. Results from two soil profiles in semi-arid South Australia: (1) a site under native (Euca-lyptus) vegetation and (2) a cleared field nearby. At the native vegetation site, the constancy of gravimetric water content, chloride concentration, and matric suction with increasing depth (range: 0 > 15 m) was notable throughout the profiles except near the surface, where the effects of a clayey sand layer and the route zone could b seen. Depth layer and the route zone could be seen. Depin profiles from the adjacent field, which was cleared 9 yr previously, showed a pressure front developed at about 7.5 m and a solute front somewhat lower in the profile than was seen in the native vegetation area. The solute front in the cleared area is tion area. The solute from in the cleared area is interpreted as representing the boundary between water stored in the soil before clearing and that which has entered since clearing. The water entering the profile post-clearing moved downward and displaced the 'pre-clearing' water ahead of it, leading to the downward propagation of the pressure front ahead of the solute front. Below the pressure front ahead of the solute front. Below the pressure front the soil water is still moving at the new rate. When the pressure front reaches the water table, water of high salt concentration will be added to the aquifer at the post-clearing recharge rate. The high salt flux to the aquifer will continue until the solute front reaches the water table; then water of relatively low salt content will enter the aquifer at the same rate. Thus the water table will continue to rise, but its salinity will decrease. (Rochester-

STUDY OF SOIL WATER CHANGES IN A PEANUT FIELD (IN CHINESE).
National Taiwan Univ., Taipei. Dept. of Agricul-

National Taiwan Univ., Taiper. Dept. of Agricultural Engineering.
C.-L. Chen, and K.-H. Houng.
Memoirs of the College of Agriculture National
Taiwan University, Vol. 29, No. 1, p 1-17, April
1989. 11 fig, 6 tab, 25 ref. English summary.

Descriptors: *Peanuts, *Soil water, *Soil-waterplant relationships, Taiwan, Comparison studies, Computer programs, Gypsum block method, Irrigation requirements, Simulation, Soil moisture

Gypsum blocks were used for monitoring soil moisture contents of peanut fields in Taipei and Tainan. The results are compared with changes in I annan. The results are compared with changes in soil moisture contents as predicted by a growth simulation program, PNUTGRO, as a way of testing the usefulness of the gypsum block method and the simulation model. For Taipei soil, the soil moisture content as measured by the gypsum block method were consistently higher than the actual values as measured by the standard gravitational values as measured by the standard gravita method, when the soil moisture contents were close to or higher than the field capacities. The gypsum block method could approximate the field moisture contents fairly closely when the moisture contents were much lower than the field capaccontents were much lower than the field capacities. When the measured resistances were higher than about 900 ohms, regression coefficient was 0.9762. For Tainan soil, the moisture contents measured by the gypsum block method significantly overestimated the actual values, but at higher electrical resistance ranges the moisture contents given by the gypsum block method were fairly close to the values predicted by the PNUTGRO program. In the later stages of growth the soil moisture contents in the peanut field in Tainan declined to levels close to the wilting percentage. Irrigation at these stages is essential to ensure a good harvest of peanuts. In Taipei, the soil moisture contents remained sufficiently high and the ture contents remained sufficiently high and the irrigation requirement was minimal. For soil moisture potentials > 1 bar, the gypsum block method can reflect sensitively the soil moisture status and is effective in monitoring the soil moisture contents to avoid reaching the wilting percentage. (Author's abstract)

W90-06905

ALUMINUM CHEMISTRY OF ACIDIC SANDY SOILS WITH VARIOUS INPUTS OF ACIDIC DEPOSITION IN THE NETHERLANDS AND

Agricultural Univ., Wageningen (Netherlands). For primary bibliographic entry see Field 5B. W90-06937

ESTIMATING THE SOIL MOISTURE RETENTION CHARACTERISTIC FROM TEXTURE, BULK DENSITY, AND CARBON CONTENT. Katholieke Univ. Leuven (Belgium). Lab. of Land Management.

Management. H. Vereecken, J. Maes, J. Feyen, and P. Darius. Soil Science SOSCAK, Vol. 148, No. 6, p 389-403, December 1989. 7 fig, 8 tab, 45 ref.

Descriptors: **Estimating equations, **Regression analysis, **Soil moisture retention, **Soil properties, **Soil tests, **Soil texture, **Soil water, **Statistical models, Carbon content, Data interpretation, Density, Particle-size distribution, Sensitivity analysis.

The soil horizons of 40 important Belgian soil series were with textures ranging from sand to heavy clay, and their moisture retention character-istic (MRC) measured. Of these horizons, the parti-cle-size distribution in nine fractions, the dry bulk cle-size distribution in nine fractions, the dry bulk density, and the carbon content were determined as well. The Van Genuchten equation reduced to four parameters on the basis of a model comparison technique, was fitted through the measured MRCs using Marquardi's algorithm for nonlinear parameter estimation. A one-dimensional sensitivity analysis was performed on the optimized parameter. eters of different MRCs to check their relative importance and stability. Principle factor analysis was used to reveal the structure in the data and to examine the relation between MRC parameters and measured soil properties. To test the need for detailed information regarding the textural compo-sition of the soil, two information levels were used. sucon of the soin, two information levels were used. The first level contains the textural composition in three fractions (sand, silt, and clay) while the second level takes into account the textural composition in nine fractions and two distributional parameters (GMPS, GSD). It was concluded that the MRC can be estimated at a reasonable level of the MRC can be estimated at a reasonable level of accuracy from such simple soil properties as a particle size distribution, dry bulk density, and carbon content. Detailed information on the particle-size distribution results in a better estimation of the parameters describing the shape of the MRC. The study further shows that for the prospected horizons the Van Genuchten model gives a good description over the entire range of the MRC. In addition, it has been shown that the approach is flexible enough to model the MRC for a wide range of textures. (Author's abstract) W90-06982

EVALUATION OF SPATIAL DISTRIBUTION OF HYDRAULIC CONDUCTIVITY USING EF-

OF HYDRAULIC CONDUCTIVITY USING EF-FECTIVE POROSITY DATA.

Agricultural Research Service, Durant, OK.
Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2F.
W90-06983

SOIL THERMAL EMISSIVITY AS AFFECTED BY ITS WATER CONTENT AND SURFACE TREATMENT.

Academia Sinica, Beijing (China). Inst. of Geogra-

J. M. Chen, B. J. Yang, and R. H. Zhang. Soil Science SOSCAK, Vol. 148, No. 6, p 433-435, December 1989. 2 fig, 1 tab, 5 ref.

Descriptors: *Instrumentation, *Measuring instruments, *Soil surfaces, *Soil temperature, *Soil water, *Temperature effects, Clay soils, Soil porosity, Soil treatment, Thermometers.

A simple and reliable device equipped with an infrared thermometer was designed for measuring soil thermal emissivity. Emissivity was measured in the field for silty clay soil of different water con-

tents under two treatments: (1) tilled (plowed and raked), and (2) tilled and compacted. The increase in soil water content results in an increase in the thermal emissivity. This increase is more apparent in the compacted soil. Soil water fills in the pore in the compacted soil. Soil water fills in the pore space between soil particles and forms thin films that have an emissivity close to 1, much higher than that of soil particles. When the surface is rough, such as tilled and uncompacted treatment, the incident soilistic and incompacted treatment, rougn, such as their and uncompacted treatment, the incident radiation undergoes several reflection and absorption processes within the large pores and water films may not add significantly to the amount of radiation absorbed. But in the compacted soil such multireflectional processes may be greatly reduced, and hence emissivity or the absorptivity is correspondingly reduced. In this case become effective in changing the radiation property of the surface, resulting in a significant increase in the bulk emissivity. More detailed studies of the mechanism are required. (Author's abstract)

CORRELATION OF SPATIALLY VARIABLE SOIL WATER RETENTION FOR A SURFACE

Louisiana State Univ., Baton Rouge. Dept. of Agronomy.

D. S. Burden, and H. M. Selim.

Soil Science SOSCAK, Vol. 148, No. 6, p 436-447, December 1989. 11 fig, 3 tab, 29 ref.

Descriptors: *Hydraulic conductivity, *Mathematical analysis, *Soil moisture retention, *Soil sutration, *Soil surfaces, *Soil water, Correlation analysis, Correlation coefficient, Density, Field capac-

The variability of soil moisture retention was stud-The variability of soil moisture retention was studied in space over a wide range of suctions for an Olivier soil. Soil moisture at field capacity; saturation; and 0.005-, 0.01-, 0.03-, 0.1-, and 1.5-MPa suctions was measured on undisturbed soil cores, which were sampled at 30-cm spacing from the soil surface along an 80 meter transect. The soil cores were further used for laboratory measurements of saturated hydraulic conductivity (K), bulk density, and particle-size fractions. As suctions increase. saturated hydraulic conductivity (K), bulk density, and particle-size fractions. As suctions increased, the correlation coefficients (CV) for the corresponding moisture contents increased. Lowest CVs were obtained for bulk density and silt fractions, whereas the highest CV was for measured K along the transect. Semivariogram analysis indicated extensive spatial structure for soil moisture data sets at most suctions, with 50% of the sample variance attributed to spatial variation. However, lack of attributed to spatial variation. However, tack or spatial structure, i.e. pire nugget effect, was obtained for moisture data sets at low suctions (0.005 and 0.01 MPa). This semivariogram finding was consistent with results based on autocorrelation analyses. Moreover, no clear patterns were observed for the range of spatial influence or length of correlation for soil moisture with increased suctions. We concluded that the extent of spatial increase of spatial successions of the confidence of th structures for soil moisture was not influenced by the degree of tension in the 0-1.5-MPa range. In the degree of tension in the 0-1.5-MPa range. In addition, cross-correlogram results indicated that optimum correlations were obtained for field capacity and theta at 0.03 MPa and for field capacity and bulk density observations. Poorly defined ranges with significance but low correlations were obtained for field capacity and K and for field capacity and the silt fraction. (Author's abstract) WEOLOGOS.

SOIL MOISTURE AND THE PERSISTENCE OF NORTH AMERICAN DROUGHT.

Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.

and Geophysics. R. J. Oglesby, and D. J. Erickson. Journal of Climate JLCLEL, Vol. 2, No. 11, p 1362-1380, November 1989. 14 fig, 1 tab, 37 ref. NASA Contract NAS8-36356, NSF Grants SCD 36211006 and 35631016.

Descriptors: *Air circulation, *Air-earth interfaces, *Climates, *Climatology, *Drought, *North America, *Soil water, Atmosphere, Gulf of Mexico, Model studies, Numerical analysis, Rainfall penetration, Weather.

Water In Soils—Group 2G

Numerical sensitivity experiments are presented that explored the effects of soil moisture on North American summer time climate using the NCAR CCMI, a 12-layer global atmospheric general circulation model. In particular, the hypothesis that culation model. In particular, the hypothesis that reduced soil moisture may help induce and amplify warm, dry summers over midlatitude continental interiors was examined. Equilibrium climate statistics were computed for the perpetual July model response to imposed soil moisture anomalies over North America between 36 and 49 degrees N. In addition, the persistence of imposed soil moisture anomalies was examined through use of the seasonal cycle mode of operation with use of various initial atmospheric states both equilibrated and nonequilibrated to the initial soil moisture anomaly. The climate statistics generated by these model nonequilibrated to the initial soil moisture anomaly. The climate statistics generated by these model simulations resembled, in general, those of the summer of 1988, when extensive heat and drought occurred over much of North America. A reduction in soil moisture in the model leads to an increase in surface temperature, lower surface pressure, increased ridging aloft, and a northward shift of the jet stream. Low-level moisture advection from the Gulf of Mexico is important in determining where persistent soil moisture deficits can be maintained. In seasonal cycle simulations, it took longer for an initially unequilibrated atmostook longer for an initially unequilibrated atmosphere to respond to the imposed soil moisture anomaly, via moisture transport from the Gulf of Mexico, than when initially the atmosphere was in Mexico, than when initially the atmosphere was in equilibrium with the imposed anomaly; i.e., the initial state was obtained from the appropriated perpetual July simulation. The results demonstrate the important role of soil moisture in prolonging and/or amplifying North American summertime drought. (Author's abstract)

PATTERNS OF STRATIFIED SOIL WATER LOSS IN CHIHUAHUAN DESERT COMMUNI-

San Diego State Univ., CA. Systems Ecology Research Group.
D. L. Moorhead, J. F. Reynolds, and P. J.

Soil Science SOSCAK, Vol. 148, No. 4, p 244-249, October 1989. 3 fig, 1 tab, 22 ref. NSF grants BSR-8507380 and BSR 82-12466.

Descriptors: *Arid lands, *Arid zone, *Deserts, *Evaporation, *Evapotranspiration, *Soil moisture deficiency, *Soil water, *Soil-water-plant relationships, *Water loss, Drought, Soil horizons, Topsoil.

An accurate assessment of the moisture content of surface soils in arid and semi-arid systems is neces-sary to predict the productivities of shallow-rooted sary to predict the productivities of shallow-rooted plants and decomposition rates of surface and near-surface litter. Soil water loss has often been as-sumed to proceed in a stepwise manner, beginning at the surface and proceeding to deeper layers as the profile dries. However, recent studies suggest that plants draw water simultaneously from many or all soil layers where roots are present. The or an son fayers where roots are present. The potential significance of this phenomenon was examined in a semiarid ecosystem utilizing two simulation models, one integrating soil water loss throughout the profile and the other sequentially removing water from soil horizons. Field observations indicate greater moisture retention in shallow soils than could be explained by a stepwise removand of water, a better correlation was achieved by simultaneously drawing water from all horizons. (Author's abstract)
W90-07081

ETHYLENE DIBROMIDE: PERSISTENCE IN SOIL AND UPTAKE BY PLANTS. Connecticut Agricultural Experiment Station, New Haven. Dept. of Soil and Water. For primary bibliographic entry see Field 5B. W90-07082

ESTIMATING UNSATURATED HYDRAULIC CONDUCTIVITY FROM EASILY MEASURED SOIL PROPERTIES.

Katholieke Univ. Leuven (Belgium). Lab. for Land Management.

H. Vereecken, J. Maes, and J. Feyen. Soil Science SOSCAK, Vol. 149, No. 1, p 1-12, January 1990. 6 fig, 5 tab, 32 ref.

Descriptors: *Flow characteristics, *Hydraulic conductivity, *Mathematical models, *Organic carbon, *Soil density, *Soil texture, *Soil water, Crust method, Hot air method, Regression analy-

The hydraulic conductivity and the soil water characteristic are important factors in describing soil water movement. Hydraulic conductivity (saturated and unsaturated) measurements were taken for a wide variety of Belgian soil series. The hot air method and the crust method were comnot ar method and the crust method were com-bined to obtain the complete range of hydraulic conductivity from saturation to air-dry. The tex-tural composition, the organic carbon content, and the dry bulk density were determined for each of the dry bulk density were determined for each of the sample horizons as well. Four different empirical models were evaluated on their performance in describing the measured hydraulic conductivity curves. The model parameters were estimated by linear and nonlinear regression techniques. The Gardner equation (1958) seems to best describe the hydraulic conductivity for the given soils. Regression equations for estimating the Gardner parameters were established from simple soil properties, such as soil texture, carbon content, bulk density, and saturated hydraulic conductivity. The three parameters can be reasonably well estimated from the textural composition and the saturated hydraulic conductivity. (Author's abstract) W90-07106

INFILTRATION IN SATURATED SWELLING SOILS AND SLURRIES: EXACT SOLUTIONS FOR CONSTANT SUPPLY RATE, Commonwealth Scientific and Industrial Research

Organization, Canberra (Australia). Div. of Envi-ronmental Mechanics.

Po. Broadbridge.
Soil Science SOSCAK, Vol. 149, No. 1, p 13-22,
January 1990. 6 fig, 32 ref, append.

Descriptors: *Infiltration, *Mathematical models, *Soil saturation, *Soil types, *Soil water, Diffusivity absorption capacity.

The infiltration of water into swelling soil is of considerable interest to agricultural and civil engineering and, more generally, to terrestrial ecology. Analytically solvable physically based mathematical models of the water infiltration are needed. In a Lagrangian material coordinate system, flow in a saturated swelling soil or slurry is governed by a nonlinear convection-diffusion equation. Analysis of the Lagrangian diffusivity function shows that typically, at moderate moisture levels, diffusivity depends weakly on moisture content though, at high moisture contents, it decreases strongly. In high moisture contents, it decreases strongly. In either case, exact solutions may be found for some relevant analytic flow models. One of the spin-offs of these exact solutions is the direct analytic prediction of the time to incipient ponding under conditions of constant water supply rate, thereby extending previous analytic estimates that applied only to rigid porous media. (Author's abstract) W90-07107

USING SURFACTANTS TO ENHANCE DRAIN-AGE FROM A DEWATERED COLUMN. Texas Tech Univ., Lubbock. Dept. of Plant and

Soil Science. Soil Science. SOSCAK, Vol. 149, No. 1, p 52-55, January 1990. 3 tab, 8 ref.

Descriptors: *Aquifer management, *Aquif *Drainage, *Nonionic surfactants, *Surfacta Anionic surfactants, Cationic surfactants, Sand.

The efficacy was determined of surfactants as secondary recovery agents to enhance drainage from a previously dewatered sand column. Seventeen surfactants at concentrations of 0, 0.01, 0.1, 1.0, surfactants at concentrations of 0, 001, 0.1, 1.0, 10.0 and 100 g (solid) or ml (liquid) surfactants per liter of water were evaluated. Anionic, cationic, and nonionic classes of surfactants were represented. Surfactant solutions (150 ml) were added to the

top of dewatered sand columns (0.1-m diameter by 0.5-m length), and column outflow was measured. Each treatment was replicated four times. Between surfactants additions, columns were cleaned with 500 ml of methanol and 750 ml of tap water. Outflow significantly increased as the log of surfactant concentration increased, but no surfactant class was significantly more efficient than any other class. Surface tension was significantly correlated with log of concentration (-0.73) and outflow (-0.42). This indicated that decreases in surface tension are associated with increase in column dewatering. Outflows from the less than 1 g or ml surfactant per liter of water treatment were not surfactant per liter of water treatment were not significantly different from the blank (no surfacsignificantly different from the blank (no surfactant). Surfactant chemistry was additionally evaluated using several Igepal DM surfactants with differing numbers of ethyleneoxy (EO) units. Maximum outflow occurred at EO ratios of 15.3, indicating that surfactant chemical structure is also important. The high concentration of surfactant required to show significant benefits (1 g or ml per L) probably precludes use of surfactants as secondary recovery agents for water. (Author's abstract) W90-07109

PERSISTENCE, LEACHABILITY, AND LAT-ERAL MOVEMENT OF TRICLOPYR (GARLON) IN SELECTED CANADIAN FOR-ESTRY SOILS.

Guelph Univ. (Ontario). Dept. of Environmental Biology.

For primary W90-07176 ary bibliographic entry see Field 5B.

APPLICATION OF GAUSS PRINCIPLE OF LEAST CONSTRAINT TO THE INFILTRA-TION INTO UNSATURATED SOIL

Alexandria Univ. (Egypt). Faculty of Engineering. Y. Z. Boutros, H. Mansour, and I. A. El-Awadi. Applied Mathematical Modelling AMMODL, Vol. 13, No. 12, p 716-723, December 1989. 10 fig. 2 tab. 8 ref, appe

Descriptors: *Furrows, *Infiltration, *Pipes, *Soil water, Gauss principle, Mathematical models, Unsaturated flow.

This paper presents a new method for solving the problem of infiltration into unsaturated soils using the Gauss principle of least constraint. This techthe Gauss principle of least constraint. This technique gives a reasonable qualitative as well as quantitative picture of moisture condition during the unsteady infiltration from both semicircular furrows and buried pipes. The results are in good agreement with those obtained by the alternating direction implicit (AID) difference method. The computation time is reduced to about 1/900 of that of the AID method. (Author's abstract)

PERMEABILITY OF AIR AND IMMISCIBLE ORGANIC LIQUIDS IN POROUS MEDIA.

Battelle-Northwest, Richland, WA. For primary bibliographic entry see Field 5B. W90-07210

LEACHATE QUALITY FROM GYPSUM NEU-TRALIZED RED MUD APPLIED TO SANDY

SOILS.
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
G. E. Ho, K. Matthew, and P. W. G. Newman.
Water, Air and Soil Pollution WAPLAC, Vol. 47,
No. 1-2, p 1-18, September 1989. 8 fig. 4 tab, 14 ref.

Descriptors: *Gypsum, *Leachates, *Sandy soils, *Soil amendments, *Soil chemistry, *Water quality, Aluminum, Bauxite refining residue, Cadmium, Catchment areas, Estuaries, Fluorides, Iron, Path of pollutants, Phosphates, Red mud, Salts, Sulfates.

Mixtures of fine bauxite refining residue (red mud), waste gypsum and local sandy soil that are pro-posed to be used in a catchment nutrient manage-ment program were watered in columns simulating rainfall over a period of 2 yr and the quality of the leachate determined. The major salts released were

Field 2—WATER CYCLE

Group 2G-Water In Soils

sodium sulfate, a product of red mud alkalinity neutralization by gypsum, and excess gypsum re-leased at its solubility concentration. At an applica-tion rate of 850 t/ha of red mud the salts leached to groundwater (40 kg/t red mud) would be equiva-lent to salts leached by rainfall over a 20 yr period from soil without red mud application, and would pose no significant impact when applied to the sandy agricultural soils in the catchment area of an estuary. The leaching of Al, Fe, and Cd from the estuary. The leacning or AI, Fe, and Ca from the red mud and gypsum was negligible, while the retention of superphosphate was over 99%. Fluo-ride from the waste gypsum was leached rapidly and reduced to background concentration (less than 1 mg/L) within one winter rainfall. (Author's abstract) W90-07217

ATRAZINE AND METOLACHLOR IN SUB-SURFACE DRAIN WATER IN LOUISIANA. Agricultural Research Service, Baton Rouge, LA. For primary bibliographic entry see Field 5B. W90-07316

PREFERENTIAL MOVEMENT OF PESTI-CIDES AND TRACERS IN AGRICULTURAL

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
For primary bibliographic entry see Field 5B.
W90-07319

ANALYTICAL SOLUTION TO RICHARDS' EQUATION FOR A DRAINING SOIL PROFILE.

Arizona Univ., Tucson. Dept. of Soil and Water

Science.
A. W. Warrick, D. O. Lomen, and A. Islas.
Water Resources Research WRERAQ, Vol. 26,
No. 2, p 253-258, February 1990. 3 fig. 1 tab, 19
ref, 2 append. EPA and Western Regional Research Project W-128 and EPA Grant CR-814243-01-10.

Descriptors: *Drainage, *Richards equation, *Soil profiles, *Soil water, Diffusivity, Hydraulic conductivity, Mathematical equations.

Analytical solutions are developed for the Rich ards' equation following the recent analysis of Broadbridge and White. A solution is included for drainage and redistribution of a partially or deeply wetted profile. Also, infiltration for various initial conditions is examined including evaporation at the upper boundary. In all cases, the surface flux is constant, whether it be zero for drainage, positive constant, whether it be zero for drainage, positive for infiltration, or negative for evaporation. The solutions assume specific forms for the soil water diffusivity and hydraulic conductivity functions. The examples described are for Yolo light clay and Brindabella silty clay loam, using the hydraulic Brindabella silty clay loam, using the hydraulic properties employed by Broadbridge and White. The present analytical solution to Richards' equation for drainage conditions may be the only one available that includes the effect of gravity. Although algebraic relationships are involved, calculations are extremely rapid with minimal numerical difficulties. (Rochester-PTT) W90-07354

ANALYSIS OF SOLUTE REDISTRIBUTION IN A HETEROGENEOUS FIELD, Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition. For primary bibliographic entry see Field 5B. W90-07356

EFFICIENT NUMERICAL METHODS FOR IN-FILTRATION USING RICHARDS EQUATION.
Commonwealth Scientific and Industrial Research
Organization, Townsville (Australia). Div. of Soils.
P. J. Ross.

Water Resources Research WRERAQ, Vol. 26, No. 2, p 279-290, February 1990. 8 fig, 2 tab, 23

Descriptors: *Infiltration, *Mathematical equations, *Richards equation, Computers, Finite dif-

ference methods, Performance evaluation, Soil water.

Two efficient finite difference methods for solving Richards' equation in one dimension are presented, and their use in a range of soils and conditions is reported. Large time steps are possible when the mass-conserving mixed form of Richards' equation is combined with an implicit iterative scheme, while a hyperbolic sine transformation for the matric potential allows large spatial increments even in dry, homogeneous soil. Infiltration in a range of soils can be simulated in a few seconds on a personal computer with errors of only a few percent in the amount and distribution of soil water. One of the methods adds points to the space water. One of the methods adus points to the space grid as an infiltration or redistribution front ad-vances, thus gaining considerably in efficiency over the other fixed grid method for infiltration problems. In 17 sec of computing (AT compatible with a floating point coprocessor running at 8 MHz), this advancing front method simulated infiltration, redistribution, and drainage for 50 days in an inhomogeneous soil with nonuniform initial conditions. Only 16 space and 21 time steps were conditions. Only to space and 21 time steps were need for the simulation, which included early ponding with the development and dissipation of a perched water table. (Author's abstract)

HYDRAULIC CONDUCTIVITY AND UNFRO-ZEN WATER CONTENT OF AIR-FREE ZEN WATER FROZEN SILT. AIR-FREE Cold Regions Research and Engineering Lab., Hanover, NH. For primary bibliographic entry see Field 2C. W90-07360

MUTAGENIC ACTIVITY IN GROUNDWATER IN RELATION TO MOBILIZATION OF OR-GANIC MUTAGENS IN SOIL. Waterlaboratorium Oost, Doetinchem

Stichting Wa (Netherlands). For primary bibliographic entry see Field 5C. W90-07397

SPECIATION OF IONIC ALKYLLEAD IN PO-TABLE WATER AND SOIL.

Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

For primary bibliographic entry see Field 5B.

MODELING SOLUTE TRANSPORT IN SOILS IN THE PRESENCE OF DISSOLVED HUMIC SUBSTANCES

National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W90-07401

EFFECT OF LUCERNE ON RECHARGE TO CLEARED MALLEE LANDS: RESULTS OF A EUSTON AND BALRANALD. BURONGA.

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water

K. L. McEwan, G. R. Budd, A. K. Kennett-Smith, P. G. Cook, and G. R. Walker. Technical Memorandum 90/2, January 1990. 48p, 24 fig, 20 tab, 3 ref.

Descriptors: *Alfalfa, *Australia, *Groundwater recharge, *Vegetation effects, Chlorides, Clays, Eucalyptus, New South Wales, Soil analysis, Soil suction. Soil water.

This report presents the results of a drilling program carried out between December 1988 and June 1989 at field sites near Buronga, Euston and Balranald, south-western New South Wales. The sites were located on cleared mallee country, which as been used for dryland farming (crops and which as ocen beat for tryant animage (crops and pasture). The aim of the project was to determine whether growing lucerne (alfalfa) on such land could deplete the extra moisture stored in the soil since clearing and thus reduce recharge. Seventeen

holes were drilled under lucerne and at one site. three holes were drilled in pasture adjacent to lucerne holes. Soil samples were analyzed for water content, chloride concentration, matric suc-tion and soil texture. Data presented as figures and tables: (1) gives the relative locations of the holes at each of the field sites; (2) results of the soil analyses; (3) gravimetric water content; (4) chloride concentration in the soil water; (5) matric suction; and (6) percent clay for each hole. (Lantz-PTT) W90-07484

2H. Lakes

DYNAMICS OF SILICA IN A SHALLOW, DIATOM-RICH SCOTTISH LOCH: I. STREAM INPUTS OF THE DISSOLVED NUTRIENT. Institute of Terrestrial Ecology, Edinburgh (Scot

A. E. Bailey-Watts, I. R. Smith, and A. Kirika. Diatom Research, Vol. 4, No. 2, p 179-190, 1989. 5 fig, 4 tab, 46 ref.

Descriptors: *Cycling nutrients, *Diatoms, *Lakes, *Limnology, *Scotland, *Silica, *Water chemistry, Annual streamflow, Catchment areas, Chemical properties, Rainfall, Seasonal variation, Streamflow, Streams, Temperature, Water sampling.

Dissolved silica was measured in five feeder streams to Loch Leven, Scotland, sampled at 8-day intervals throughout 1985. Similar mean concentrations (8.7 to 10.7 mg SiO2/L) and narrow ranges of values were found in all, in spite of a 25fold variation in subcatchment area and a 63-fold variation in mean annual flow. As a consequence, variation in loading (the product of concentration and flow) within and between sites, mainly reflects variation in flow rather than in SiO2 concentra-Various methods of calculating loading were tion. Various methods of calculating loading were explored, but even for a site where continuous flow records were available, a total of 7 methods gave similar answers (annual mean instantaneous loads of 8208 to 8815 mg SiO2/sec). It is possible that this close agreement reflects a chance similarity between the frequency distribution of the flow values recorded at the instants of sampling and that of the flow recorded continuously. Annual loads of the flows recorded continuously. Annual loads from the five streams ranged from 7.3 to 448.9 from the five streams ranged from 1.3 to 48.8; tonnes SiO2, and assuming a prorata loss of SiO2 to the loch from the 14% of the area of its catchment not drained by these waters, a total input of 1157 tonnes SiO2 to the loch can be calculated. Areal losses from the subcatchments ranged from 42.5 to 104.4 kg SiO2/ha/year and increased exponentially with catchment area; these values are ponentially with catchment area; these values are compared with corresponding data in the literature. Plots of the year's individual sample results confirm the insensitivity of SiO2 concentration to changes in flow and a multivariate analysis—not reported here—involving rainfall and temperature did not explain the relationships any more effectively. However, a graph of moving averages (each of 3 points) revealed distinct seasonal differences in the concentration-flow relationship, although reference to the timing of major agricultures. though reference to the timing of major agricultural activities in the catchment provided few clues as to the causes of these patterns. (See also W90-06576) (Author's abstract)

DYNAMICS OF SILICA IN A SHALLOW DIATOM-RICH SCOTTISH LOCH: II, THE INFLUENCE OF DIATOMS ON AN ANNUAL

BUDGET. Institute of Terrestrial Ecology, Edinburgh (Scot-

A. E. Bailey-Watts, I. R. Smith, and A. Kirika. Diatom Research, Vol. 4, No. 2, p 191-205, 1989. 9 fig, 1 tab, 33 ref.

Descriptors: "Cycling nutrients, "Diatoms, "Lakes, "Limnology, "Scotland, "Silica, "Streams, "Water chemistry, Asterionella, Chemical properties, Fragilaria, Melosira, Nutrient budget, Outlets, Season-

Stream inputs of soluble reactive silica, changes in its concentration in the loch and its export via the

Lakes-Group 2H

outflow of Loch Leven, Scotland, and in-loch shifts in diatom silica were estimated from samples collected every 8 days from January 11 to December 13, 1985. A silica budget was erected for the whole period and, by considering the data in fourteen 24-day blocks, seasonal changes in the various component terms were assessed. In the absence of direct chemical determinations, the opal in the diatom assemblages (dominated by unicellular Centrales and Asterionella formosa) was estimated as follows: for the discoid forms, from cell dimensions and published values suggesting a general ratio of cell volume to silica volume of 10:1, and for Asterionella (and populations of Fragilaria and Melosira) from other published values. Stream for Asteriolicia (and populations of riagnaria and Melosira) from other published values. Stream inputs of 953 tonnes soluble reactive silica over the 336 days are equivalent to 97% of the total in-crease in opaline silica of 985 tonnes, including 70 tonnes passing down the outflow. However in the amounts of soluble reactive silica present in the loch at the beginning (383 tonnes) and the end (178 tonnes) of the period and that exported (282 tonnes) are taken into account, only 876 tonnes was made available. Although the flux of soluble was made available. Although the flux of soluble reactive silica to the sediment represents only 40% of the external loading over the whole period, the daily rates (equivalent to 34-362 mg SiO2/square m of loch floor) over the 24-day blocks were commonly equivalent to 3 times the amounts of soluble reactive silica arriving meanwhile from the feeder streams. Internal loading is especially important in supporting the post-spring diatom populations; by contrast, the late winter-early spring crop is able to draw on the initial reservoir of soluble reactive silica in the loch. (See also W90soluble reactive silica in the loch. (See also W90-06575) (Mertz-PTT) W90-06577

QUANTITATIVE ESTIMATION OF DIATOM ALGAE USING THE SCANNING AND TRANSMISSION ELECTRON MICROSCOPES.

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.

For primary bibliographic entry see Field 7B. W90-06578

ECOLOGICAL STUDIES ON THE PLANK-TONIC PROTOZO OF A EUTROPHIC RESER-VOIR (RIO GRANDE RESERVOIR-BRAZIL). Universidade Federal de Sao Carlos (Brazil). Dept. de Ciencias Biologicas.

S. M. Barbieri, and M. J. L. Godinho Orlandi. Hydrobiologia HYDRB8, Vol. 183, No. 1, p 1-10, October 2, 1989. 11 fig, 1 tab, 24 ref.

Descriptors: *Aquatic populations, *Brazil, *Population density, *Protozoa, *Reservoirs, *Seasonal variation, *Spatial distribution, *Condonella, Copeps, Difflugia, Ecological distribution, Halteria, Mesodinium, Tintinnidium, Urotricha, Vorticella.

The abundance, composition and seasonal distribu tion of planktonic protozoans and physical and chemical variables such as temperature, dissolved oxygen content, pH, and chlorophyll a concentraoxygen content, pri, and entorphyin a contential tion were analyzed monthly from February 1985 to January 1986 in the eutrophic Rio Grande Reservoir, located in Sao Paulo State, Brazil. Analyses were performed on water samples collected at the were periodined on water samples concelled at time surface and bottom (0.5 m above the sediment) in three stations, and individual distribution profiles were constructed for the major species. Populations showed a very clear temporal and spatial distribution. Highest densities occurred in December at station 2 and in March bottom samples at station 3. The dominant species of protocos were ber at station 2 and in March bottom samples at station 3. The dominant species of protozoa were Codonella cratera, Coleps amphacanthus, Coleps hirtus, Halteria grandinella, Mesodinium pulex, Tintinnidium sp., Urotricha spp., Vorticella spp., and Difflugia sp. Species such as Coleps amphacanthus, Coleps hirtus, and Halteria grandinella were mainly observed in summer samples. Codonella cratera and Coleps amphacanthus occurred at bottom samples, whereas Vorticella sp. at surface ones, suggesting that the distribution of some species was affected by temperature and dissolved cies was affected by temperature and dissolved oxygen content. (Mertz-PTT) W90-06580

CILIATED PROTOZOAN COMMUNITIES IN A FLUVIAL ECOSYSTEM. Barcelona Univ. (Spain). Facultat de Biologia. M. del Pilar Gracia, C. Castellon, J. Igual, and R.

Sunyer. Hydrobiologia HYDRB8, Vol. 183, No. 1, p 11-31, October 2, 1989. 27 fig, 1 tab, 15 ref.

Descriptors: *Population distribution, *Protozoa, *Rivers, *Spain, *Water pollution effects, Aspidisca, Colpidium, Cyclidium, Ecological distribution, Lionotus, Oxygen, River flow, Seasonal distribution, Spatial distribution, Water temperature.

The ciliated protozoan communities in the Llobregat River in Barcelona, Spain were studied for one year. Samples were taken from 11 different stations to study the physical-chemical factors of the water as well as the qualitative and quantitative nature of the ciliate populations. 105 species of ciliates, grouped in 13 orders were found. The dynamics of the ciliated protozoan communities in the Llobregat River, similar to those of other fluwial courses, showed great fluctuations due to flow variations as well as to the vigorous chemical changes of the environment. These changes are mainly caused by the heterogeneity of the waste matter which these waters receive. Flow differences also caused the oxygen content and temperature to vary. During the study year (1984) the highest numbers of spethe study year (1984) the highest numbers of species were found in the middle section of the river, cies were found in the middle section of the river, which had 17 species in June and 21 species in July. The most abundant species in the higher stretches of the river were Aspidisca lynceus, Cyclidium glaucoma, Litonotus fasciola and Colpidium colpoda. In the middle of the river, Cyclidium glaucoma, Aspidisca lynceus, Euplotes sp., Trithigmostoma cuculluls, Holosticha sp. and Vortallula, and Colpidium colpositions of the college of the Tritingmostoma cucultus, ritoristicas sp. and vorticella microstoma were most numerous, while in the lower stretches Aspidisca lynceus, Aspidisca costata, Tritingmostoma cucultulus, Paramaccium caudatum and Oxytricha sp. were numerically dominant. (Mertz-PTT) W90-06581

EROSION, PHOSPHORUS AND PHYTO-PLANKTON RESPONSE IN RIVERS OF SOUTH-EASTERN NORWAY.

Norges Landbrukshoegskole, Aas. Dept. of Soil

T. Krogstad, and O. Lovstad. Hydrobiologia HYDRB8, Vol. 183, No. 1, p 33-41, October 1989. 13 fig, 22 ref.

Descriptors: *Algal blooms, *Erosion, *Nonpoint Descriptors: "Agai blooms, "Floyon," Nonpoun pollution sources, "Phosphorus, "Phytoplankton, "Rivers, Algae, Algal growth, Aquatic popula-tions, Norway, Seston, Soil algae, Soil chemistry, Water chemistry, Water sampling.

The development of phosphorus fractions and phy-toplankton was studied in three rivers with varying toplankton was studied in three rivers with varying concentrations of seston. In 1981 water samples were taken from one station in Leira River and Nitelva River, Norway. Samples from 19 stations in the Romua River system were taken at about 10 cm depth during 1983, 1984, and 1986. At station 8 both river samples and surface runoff samples from a corn area were collected. Surface soil samples were taken at different localities. The major stricture of the station of the samples of the samples of the samples of the samples from a corn area were taken to different localities. a corn area were collected. Surface soil samples were taken at different localities. The major agricultural soils in the watershed of Romua River were represented in the samples. Less than 1% of the yearly total phosphorus transport may take place during periods with high algal biomass. The observation of a high growth rate of phytoplankton in the rivers coinciding with high concentrations of molybdate reactive phosphorus in filtered samples, low content of seston and high total phosphorus/phorpohylla ratio, indicate that the phosphorus:chlorophyll a ratio, indicate that the growth was often not phosphorus-limiting. During short periods with high phytoplankton biomass the ratio of total phosphorus:chlorophyll a may be ratio of total phosphorus-chlorophyll a may be low, indicating that a high fraction of total phosphorus was available. The content of phosphorus in soil samples and in samples with high seston content was about 0.1% of dry weight, and the algal availability of phosphorus often varied between 25 and 75% of total phosphorus for both types of samples. Decreasing biomass or low growth rates were observed at secchi depths less than 0.5 m and seston concentrations less than about 25 mg dry weight/L. High flow rate also

depressed the development of the total phyto-plankton biomass. The assimilation of available phosphorus is incomplete under such conditions, for example, under conditions of light limitation for example, under conditions of light limitation and high dilution rate. (Mertz-PTT) W90-06582

ICTHYOLOGICAL STUDIES IN LA CUAREN-TENA LAGOON (CARABAJAL ISLAND), PARANA RIVER: DENSITY OF PROCHILO-DUS PLATENSIS HOLMBERG (CURIMATI-

Instituto Nacional de Limnologia, Santo Tome (Argentina). E. Cordiviola de Yuan, and C. Pignalberi de

Hydrobiologia HYDRB8, Vol. 183, No. 1, p 43-46, October 1989. 2 fig, 1 tab, 23 ref.

Descriptors: *Aquatic populations, *Argentina, *Biomass, *Fish, *Intermittent lakes, *Limnology, Lakes, Prochilodus, Rivers.

Carabajal Island lies in a river-bar-plain. Its boundaries are the Parana, Colastine, and Tiradero Viejo rivers, and the access channel to Santa Fe Harbor in Argentina. It contains numerous bodies of in Argentina. It contains numerous bodies of water, linked in different ways to the nearby fluvial courses. The detritivorous species Prochilodus platensis (sabalo), comprises 60% of the ichthyomass of the floodplain pools in the La Plata system. A survey was conducted of numbers and biomass of sabalo when the lagoon was isolated during a low water period. Capture-recapture data on the fish of La Cuarentena Lagoon (Carabajal Island) shows that Prochilodus platensis represented 90% of the 1287 fish tagged. By means of the Schrift of the 1287 fish tagged. By means of the Schumacher and Eschemeyer formula, it was estimated the 6681 (6657-6706) individuals were present. Total biomass of the species was calculated at 37,094 kg, representing 66.18 kg/ha. (Mertz-PTT) W90-06583

DOWNSTREAM DRIFT OF THE LARVAE OF CHIRONOMIDAE (DIPTERA) IN THE RIVER CHEW, S. W. ENGLAND.

ol Univ. (England). Dept. of Zoology.

C. J. Williams

C. J. Williams. Hydrobiologia HYDRB8, Vol. 183, No. 1, p 59-72, October 1989. 7 fig, 2 tab, 25 ref. Natural Environ-ment Research Council Grant GR3/3987.

Descriptors: *Aquatic populations, *England, *Lotic environment, *Midges, *Rivers, Diptera, Larvae, Orthocladiinae, Population distribution.

The larvae of Chironomidae (Diptera) are common in the drift of lotic waters, where this is often the most abundant family and may account for 34-85% of drifting invertebrates. The river Chew drains an area 143 square km of the north Mendip Hills, S.W. England, which are composed largely of limestone. The drift of larval Chironomidae was investigated at two gives on the Discount of the control of the property of the control of the contro dae was investigated at two sites on the River Chew, using a pump filtration system with 50 micrometers mesh-aperture aerial nets, situated on the river bank. Chironomid larvae were found to drift in far greater numbers than previously report-ed, even in slow-flowing water. First and second instar larvae dominated the drift. Variation in drifting behavior between taxa was observed, where Orthocladiinae drifted in all instars and Chironominae predominantly as first and second instars. Proportionally different rates of drift were obrroportionally different rates of unit were ob-served between these taxa from the benthos at the two sites. It is suggested that the majority of chironomid drift represents an active dispersal and colonization mechanism by which population re-distribution and habitat selection occurs. (Mertz-PTT) W90-06584

ASPECTS OF THE PHOSPHORUS CYCLE IN HARTBEESPOORT DAM (SOUTH AFRICA) PHOSPHORUS LOADING AND SEASONAL DISTRIBUTION OF PHOSPHORUS IN THE RESERVOIR

National Inst. for Water Research, Pretoria (South

Field 2-WATER CYCLE

Group 2H-Lakes

J. A. Thornton, and P. J. Ashton. Hydrobiologia HYDRB8, Vol. 183, No. 1, p 73-85, October 2, 1989. 5 fig, 3 tab, 52 ref.

Descriptors: *Municipal wastewater, *Phosphorus, *Pollution load, *Reservoirs, *South Africa, *Wastewater pollution, *Water chemistry, Hartbeespoort Dam, Pollutant identification, Seasonal

Hartbeespoort Dam, a hypertrophic, warm mono-mictic impoundment in South Africa, receives ex-tremely high phosphorus loads (14.6-25.9 g/square m/a) that are dominated by point source dis-charges from municipal wastewater treatment works. The reduced state of the phosphorus dis-charged from the works has lead to the dominance of the dissolved phosphorus pool by low molecular weight orthophosphates which are analytically de-tectable as soluble reactive phosphorus (60% of total phosphorus pool). Seasonality in the in-lake total phosphorus pool). Seasonality in the in-lake total phosphorus pool is regulated by a combination of abiotic and hydrological processes; biotic processes appear to play a minor role. Mass balance calculations indicate that between 62 and 77% of the annual total phosphorus inflow load is retained within the impoundment each year. (See also W90-06585) (Author's abstract) W90J06585

ASPECTS OF THE PHOSPHORUS CYCLE IN HARTBEESPOORT DAM (SOUTH AFRICA), PHOSPHORUS KINETICS.

National Inst. for Water Research, Pretoria (South Africa).

J. A. Thornton

Hydrobiologia HYDRB8, Vol. 183, No. 2, p 87-95, October 9, 1989. 4 fig, 6 tab, 40 ref.

Descriptors: *Algae, *Cycling nutrients, *Municipal wastewater, *Path of pollutants, *Phosphorus, *Pollution load, *Reservoirs, *Seasonal variation, *South Africa, *Wastewater pollution, Fluctua-

tions, Hartbeespoort Dam, Isotopic tracers.

Previous studies of Hartbeespoort Dam, a warm, monomictic, hypertrophic impoundment in South Africa, have suggested that, due to the influence of domestic wastewater discharges from the city of domestic wastewater discharges from the city of Johannesburg and surrounding area in maintaining high ambient concentrations of bioavailable phos-phorus, the seasonality in the dissolved phosphorus pool is largely dominated by hydrological and abiotic processes. The role of biotic processes in Hartbeespoort Dam is examined using 32P radio-bioassays. Phosphorus demand is assessed by phosbioassays. Prosphorus demand is assessed by phos-phorus turnover times, alkaline phosphatase activi-ty, cellular phosphorus status and the phosphorus deficiency index. Long turnover times indicative of an enriched system were recorded, ranging from 9 hours to 1992 hours, with no evidence of phosphohours to 1992 hours, with no evidence of phosphorus stress being present. These turnover times support the hypothesis that the phosphorus cycle in Hartbeespoort Dam is dominated by the algal comunity which is shown to play an important role in phosphorus cycling within the water column. However, hydrological processes remain the driving force in phosphorus seasonality in the lake. (See also W90-06584) (Mertz-PTT) W90-06586

QUANTITATIVE IMPORTANCE OF DIFFER-ENT PHYTOPLANKTONIC SIZE FRACTIONS ENT PHYTOPLANTIONIC SIZE FRACTIONS
IN A EUTROPHIC LAKE ENVIRONMENT
(IMPORTANCE QUANTITATIVE DE DIFFERENTES CLASSES DE TAILLE PHYTOPLANC
TONIQUES EN MILIEU LACUSTRE EU-

Clermont-Ferrand-2 Univ., Aubiere (France). Lab. de Zoologie.

de Zoologie. L. Aleya, and C. Amblard. Hydrobiologia HYDRB8, Vol. 183, No. 2, p 97-113, October 9, 1989. 9 fig, 5 tab, 71 ref. English

Descriptors: *Chlorophyll a, *Ecological distribu-tion, *Eutrophic lakes, *France, *Phytoplankton, *Population density, Adenosine triphosphate, Bio-mass, Cell enumeration, Comparison studies, Lake Aydat, Microscopy.

The distribution of three phytoplanktonic size fractions was studied in an eutrophic lake (Lake Avdat. France). Size fractionation experiments Ayout, France). Size fractionation experiments were performed using cell enumeration by inverted microscopy and chlorophyll a estimation. The results were also compared with the ATP content in the analyzed algal fractions. The (1-12 micrometer) fraction represented only on average 5% of the total biomass, when estimated by the cell enumeration method, but made up 26% of the total chlorophyll a and 33% of the total ATP. This discrepancy confirms that cell enumeration with an inverted microscope seriously underestimates the nano-plankton biomass. The (12-45 micrometer) fraction made up to 50% of the total biomass regardless the method of analysis used. The chlorophyll a and method of analysis used. The chiorophyli a and biovolume estimation in this fraction were positively correlated. The contribution of algal species with large cell size (45-160 micrometer) to the total algal biomass was higher (39%) when based on their biovolume estimation than when on the chlouser onvolume estimation than when on the chlorophyll a (27%). The low ATP contribution of this fraction (17%) may be attributable to high percentage of dead cells. (Author's abstract) W90-06587

MACROINVERTEBRATE COMMUNITIES IN WHEELER RESERVOIR (ALABAMA) TRIBU-TARIES AFTER PROLONGED EXPOSURE TO

DDT CONTAMINATION.
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures

For primary bibliographic entry see Field 5C. W90-06588

ROTIFER OCCURRENCE IN RELATION TO OXYGEN CONTENT, Uppsala Univ. (Sweden). Limnologiska Institu-

tionen.
B. Berzins, and B. Pejler.
Hydrobiologia HYDRB8, Vol. 183, No. 2, p 165-172, October 9, 1989. 4 fig, 19 ref.

Descriptors: *Lakes, *Oxygen, *Ponds, *Rivers, *Rotifers, *Sweden, *Zooplankton, Ecological effects, Mires, Oxygen demand, Plankton.

The dependence on oxygen of nonplanktic rotifers was investigated. The area covered comprises about 350 lakes, 50 ponds, 20 pools, 150 running water localities, and 15 mires in Sweden. Information on the distribution of 204 species of planktic, periphytic and benthic rotifers from diverse waters in south and central Sweden was analyzed for in sourn and central Sweden was analyzed for details on relationships to the oxygen content of the environment. No sign of truly anoxybiotic appearance was traced, although some species may be encountered in high abundance at low O2-values. Most cold-stenothermal species prefer an environment rich in oxygen, but there are a few exceptions. For the warm-stenothermal species no exceptions. For the warm-stenothermial species no really close connections with oxygen exist. Several species combine a tolerance of low oxygen content with a preference of high Pt-values. No such con-nections were traced between oxygen content and trophic degree. (Mertz-PTT) W90-06589

INFLUENCE OF DIFFERENT LITTER BAG DESIGNS ON THE BREAKDOWN OF LEAF MATERIAL IN A SMALL MOUNTAIN STREAM.

Cape Town Univ. (South Africa). Dept. of Water Resources and Public Health Engineering. For primary bibliographic entry see Field 7B. W90-06590

DECOMPOSITION RATE OF PLANT MATERIAL IN THE PARANA MEDIO RIVER (AR-GENTINA). Centro de Estudios del Agua, Santa Fe (Argenti-

118). J. Hammerly, M. Leguizamon, M. A. Maine, D. Schiver, and M. J. Pizarro. Hydrobiologia HYDRB8, Vol. 183, No. 3, p 179-184, October 15, 1989. 2 fig. 2 tab, 10 ref.

otors: *Biodegradation, *Decomposition, es, *Rivers, *Water hyacinth, Argentina, Descriptors:

Degradation, Mathematical analysis, Oxygen demand, Panicum, Paspalum, Reservoirs, Water

Degradation constants of different plant species were required for a mathematical model describing were required for a mathematical mouel describing the oxygen consumption in the future reservoir at the Parana Medio Dam. Plant degradation may be considered as an integrative function of the physi-cal, chemical, microbial and animal interactions. cal, chemical, microbial and animal interactions. The degradation of plant material in the center of two plain streams (the Parana Medio River main channel flowing at 0.6 m/s and the Colorado River flowing at 0.03 m/s) was studied in order to obtain a degradation coefficient for the species Panicum prionitis, Paspalum repens and Eichhornia crassipes, representative of the vegetation of the area where the future man-made lake of the Parana Medio Dami is to be located. The experimental sites were chosen at the limit (minimum and maximum) were chosen at the limit (minimum and maximum) were chosen at the limit (minimum and maximum) velocities of the two streams in the valley to be flooded. The plant samples (submerged at different depths) were periodically analyzed during 80 days, the experimental data being fitted to an exponential decomposition model. Degradation coefficients ranged from 0.0357 to 0.0682/day (P. prionitis); from 0.0182 to 0.0643/day (P. repens) and from 0.0120 to 0.0425/day (E. crassipes). The action of the current is most important for the soft material of hydrophytes as implifiedly expected. (Metz. of hydrophytes, as intuitively expected. (Mertz-PTT W90-06591

CONTRIBUTION OF DISSOLVED CALCIUM AND MAGNESIUM TO PHYTOPLANKTONIC PARTICULATE PHOSPHORUS CONCENTRA-TION AT THE HEADS OF TWO RIVER RES-ERVOIRS

Ehime Univ., Matsuvama (Japan), Dept. of Environment Conservation.

H. Kagawa, and M. Togashi. Hydrobiologia HYDRB8, Vol. 183, No. 3, p 185-193, October 15, 1989. 6 fig, 2 tab, 26 ref.

Descriptors: *Algae, *Calcium, *Japan, *Limnology, *Magnesium, *Phosphorus, *Reservoirs, Chlorophyll a, Mathematical equations, Regression

From the viewpoint of the chemical control of algal nutrition in lakes and ponds, it is important to clarify the participation of Ca and Mg in the algal P-nutrition in situ. A Mg/Ca quotient was proposed as a trophic state index of lakes and ponds. At the heads of two river reservoirs, the Ishi-tegawa Dam and the Normura Dam Reservoirs in Japan, the concentrations of phytoplanktonic par-ticulate phosphorus were compared with those of dissolved calcium and magnesium, using multiple regression analyses on the data taken from samples which registered more than 6.0 microgram/L in chlorophyll a concentration. Of the 27 monthly samples, 16 from the Ishitegawa Reservoir and 17 from the Nomura Reservoir were used. A signififrom the Nomura Reservoir were used. A significant regression line, log particulate phosphorus = k1(F) + k2, was obtained, where k1 (>0) and k2 were consisted of log (Ca/Mg)-0.5 log (Ca + Mg) in mol concentration in Ca and Mg, in common with the two reservoirs. The Ca-Mg index seemed to be closely related with P-nutrition rather than growth in general. In addition, another requisition factor of closely related with P-nutrition rather than growth in general. In addition, another regulating factor of P-nutrition, presumably a stimulatory factor, might be synergistic with the Ca-Mg index in the case of the Ishitegawa Reservoir, because the contribution of the Ca-Mg index to the total variance of log particulate phosphorus is low in contrast to the Nomura Reservoir. (Mertz-PTT) W90-06592

ACCUMULATION OF A PEPTIDE TOXIN FROM THE CYANOBACTERIUM OSCILLA-TORIA AGARDHII IN THE FRESHWATER MUSSEL ANADONTA CYGNEA.

Abo Akademi, Turku (Finland). Dept. of Biology. For primary bibliographic entry see Field 5C. W90-06594

EFFECT OF PHENOLIC ACIDS ON GROWTH OF CHLORELLA PYRENOIDOSA.

Wisconsin Univ.-Superior. Center for Lake Superi-or Environmental Studies.

For primary bibliographic entry see Field 5C. W90-06595

AQUATIC MACROPHYTE STUDIES ON WOODS RESERVOIR, TENNESSEE, Tennessee Cooperative Fishery Research Unit.

Cookeville. P. W. Bettoli, and J. A. Gordon.

Journal of the Tennessee Academy of Science JTASAG, Vol. 45, No. 1, p 4-8, January 1990. 2 fig, 2 tab, 24 ref.

Descriptors: *Aquatic plants, *Limnology, *Macrophytes, *Reservoirs, *Tennessee, Drawdown, Potamogeton, Sagittaria, Vallisneria.

After a system-wide decline of aquatic macro-phytes in Woods Reservoir, Tennessee, studies were initiated to determine if the reservoir sediwere influted to determine it the reservoir scannents and water quality were suitable for macrophytes. Established Vallisneria americana, Potamogeton nodosus, and Sagittaria platyphylla plants were collected and replanted at five sites on Woods Reservoir in tubs containing Woods Reservoir sediments and control sediments. Although voir sediments and control sediments. Although success of the transplants varied greatly, all three success of the transplants varied greatly, all three species survived and grew well at some of the test sites. After the winter die-back, only V. americana failed to initiate new growth the following spring. Laboratory bioassays with P. nodosus, V. americana, and Egeria densa grown in Woods Reservoir and control sediments yielded no significant differences in the ability of the different sediments to support plants. These results indicated that the sediments and water of Woods Reservoir were canable of supporting aquatic macrophytes. These sediments and water of Woods Reservoir were capable of supporting aquatic macrophytes. These conclusions were confirmed when the abundance and diversity of macrophytes in the reservoir increased following a drawdown during the winter of 1984-1985. (Author's abstract) W90-06596

URUGUAYIAN WATER-PRIMROSE (LUDWI-GIA URUGUAYENSIS) IN TENNESSEE AND KENTUCKY.

Austin Peay State Univ., Clarksville, TN. E. W. Chester, and S. E. Holt. Journal of the Tennessee Academy of Science JTASAG, Vol. 45, No. 1, p 9-12, January 1990. 2

Descriptors: *Aquatic plants, *Hydrologic data collections, *Kentucky, *Tennessee, *Water primrose, Bays, Data collections, Floating plants, Marshe, Streams, Swamps.

The Uruguayian water-primrose, Ludwigia uruguayensis (Camb.) Hara, Onagraceae, is an aquatic or semiaquatic perennial herb with long-trailing, usually floating and often matted vegetative stems that freely branch and root at the nodes. The plant appears to be a recent immigrant into the lower Cumberland River Valley of Tennessee and Kentucky; the first known collection was in 1968 from tucky; the first known collection was in 1968 from Montgomery County. Known occurrences and habitats of the potentially-troublesome aquatic weed are summarized for Tennessee and Kentucky. In the lower Cumberland River Valley collections were made in the following Tennessee counties: Montgomery (first in 1968), Sumner (1975), southern Stewart (1981), and northern Stewart (1988). The 1988 collections from Lyon and Trips counties Kentucky were the first from and Trigg counties, Kentucky, were the first from that state. Stands were often extensive and occurred in three aquatic habitat types: (1) emergent marshes and swamps around permanently-pooled bottomland depressions separated from the main river channel but flooded periodically (Montgomery and Stewart counties), (2) along the shoreline and extending outward into shallow bays of Lake Barkely (Lyon, Stewart, Trigg counties), and (3) sandy banks and gravel bars of shallow streams (Sumner County). (Mertz-PTT) W90-06597

INVESTIGATION OF ORCONECTES SHOUPI IN MILL AND SEVENMILE CREEKS, TEN-NESSEE.

NESSEE. Army Engineer Waterways Experiment Station, Vicksburg, MS. A. C. Miller, P. D. Hartfield, and L. Rhodes. Journal of the Tennessee Academy of Science JTASAG, Vol. 45, No. 1, p 21-24, January 1990. 2 fig, 1 tab, 9 ref.

Descriptors: *Crayfish, *Endangered species, *Environmental impact, *Stream biota, *Tennessee, Animal populations, Data collections, Ecological effects, Orconectes, Population density, Sedimen-

The Nashville crayfish, Orconectis shoupi Hobbs (Crustacea: Cambaridae), is currently only known from Mill and Sevenmile creeks in Davidson and Williamson counties, Tennessee. Crayfish were collected at 14 sites on Mill and Sevenmile creeks in July, 1985. The Nashville crayfish, listed as endangered by the U.S. Fish and Wildlife Service, comprised 89% of the crayfish collected in Mill creek and 1986, collected in Sevenmile creek. enaangerea by the U.S. Fish and Wildlife Service, comprised 39% of the crayfish collected in Mill creek and 29% collected in Sevenmile creek. Two similar species, O. mirus Hagen and O. palacidus Ortmann, comprised the rest of the assemblage. At sites in Mill Creek with heavy sedimentation, O. shoupi density was 4.9 +/-3.3 individuals/square m and with moderate-to-no sedimentation density was 4.6 +/-3.3 individuals/square m. These numbers were not significantly higher than at sites in Sevenmile Creek with moderate-to-no sedimentation (1.8 +/-1.9 individuals/square m, p = 0.14). Total density of Orconectes spp. in Mill Creek was significantly less than in Sevenmile Creek. Total crayfish density was not significantly different between creeks. Although O. shoupi has been reported only from nonturbid, well-oxygenated water and clean substrate, the results of this study indicate that it also occurs in pools, riffles with gravel, cobble, or slab rock, with moderate to high sedimentation. (Mertz-PTT)

CRUSTACEAN PLANKTON AND FISH DURING THE FIRST DECADE OF A SUBAL-PINE, MAN-MADE RESERVOIR. Trondheim Univ. (Norway). Museum. J. W. Jensen.

Nordic Journal of Freshwater Research, No. 64, p 5-53, 1988. 29 fig, 24 tab, 155 ref.

Descriptors: *Fish harvest, *Fish populations, *Growth, *Limnology, *Norway, *Reservoir fisheries, *Trout, Biomass, Burbot, Char, Midges, Oligotrophic lakes, Polymictic lakes.

The Nesjo reservoir, in central Norway, was made in 1970 by impounding 38.7 square km. It was studied in 1970-1983, with parallel sampling in the adjacent Essand reservoir, regulated since 1940. The reservoirs are oligotrophic and polymictic with maximum temperatures of 11-13 C. In Nesjo the biomass of crustacean plankton was at its maximum in 1970. Chironomids predominated the macrobenthos and were eaten in largest quantities by fish in 1972-1974. Brown trout, burbot and Arctic char predominated in succession net catches in the littoral zone. Until 1976, the biomass caught per net was 4-6 times higher than normal in similar Norwegian lakes. Growth rates close to the maximum lakes. net was 4-6 times higher than normal in similar Norwegian lakes. Growth rates close to the maximum known for any salmonid were recorded in 1972. Chironomids and cladocerans were the most important prey for the fish. Compared to Essand, the Nesjo cladocerans were larger, carried more eggs and represented a larger biomass. The Nesjo fish took more food, were larger and fatter, grew better and gave higher catches in weight per unit effort. These differences became less distinct but effort. These differences became less distinct, but were still noticeable by the end of the decade. The study gives additional results on the sex ratios, study gives additional results on the sex ratios, maturing, migrations, diet, size of food rations, seasonal growth cycles, population number, biomass and food conversion efficiencies of the fish, and on the interactions between planktonic crustaceans and Arctic char. (Author's abstract)

PHYSICAL HABITAT SELECTION BY BROWN TROUT (SALMO TRUITA) IN RIVER-

Norges Landbrukshoegskole, Aas. Dept. of Nature Conservation.

J. Heggenes. Nordic Journal of Freshwater Research, No. 64, p 74-90, 1988.2 tab, 66 ref.

Descriptors: *Aquatic habitats, *Fish behavior, *Trout, Fish, Stream fisheries.

Knowledge about habitat requirements of brown trout (Salmo trutta) is important for stream man-Knowledge about habitat requirements of brown trout (Salmo trutta) is important for stream management and impact assessment. The method of observation may influence the habitat suitability results obtained. The best approach may be to adopt a combination of direct underwater observation and electrofishing, if a variety of habitat conditions are studied. A distinction should be made between physical habitat variables affecting in situ habitat choice and habitat variables affecting carrying capacity, such as, boundary conditions, because ing capacity, such as, boundary conditions, their spatio-temporal dimensions are different.

Water depth, water velocity, streambed substrate
and cover seem to be the most important physical and cover seem to be the most important physical stream characteristics influencing in situ habitat choice by brown trout. Preferred habitat is positively correlated with fish size. Smaller brown trout occupy shallow riffle areas with cobble substrate, while the larger fish prefer deeper stream areas with cobble/boulder substrate and abundant cover. All sizes of fish seek out low water velocity cover. All sizes of fish seek out low water velocity micro-niches to minimize energy expenditure. Different studies emphasize the importance of different habitat variables. This is probably a reflection of the diverse factors modifying habitat selection. Total available habitat should be quantified in all habitat analysis studies, because availability can modify habitat choice strongly. Different habitat characteristics may be the limiting factors in different streams and true habitat preferences controlled. ent streams and true habitat preferences cannot therefore be constructed from habitat use data alone. Furthermore, habitat selection may be modiaione. Furtnermore, naoitat selection may be modi-fied by biological factors such as fish population density and composition, food supply and presence of other species. In addition greater attention should be given to the possible interactions be-tween physical habitat variables. (Author's ab-W90-06600

ESTIMATING THE NUMBER OF SPECIES AND RELATIVE ABUNDANCE OF FISH IN OLIGOTROPHIC SWEDISH LAKES USING MULTI-MESH GILLNETS.

Institute of Freshwater Research, Drottningholm For primary bibliographic entry see Field 5G. W90-06601

OXYGEN DEFICIT IN LAKE DOM HELVECIO (PARQUE FLORESTAL DO RIO DOCE, MINAS GERAIS), (O DEFICIT DE OXIGENIO NO LAGO DOM HELVECIO (PARQUE FLORESTAL DO RIO DOCE, MINAS GERAIS)),

Universidade Estadual Paulista, Botucatu (Brazil).

Universidade Estadual Paulista, Botucatu (Brazil). Dept. of Zoology. R. Henry, M. C. F. Pontes, and J. G. Tundisi. Revista Brasileira de Biologia RBBIAL, Vol. 49, No. 1, p 251-260, February 1989. 2 fig, 4 tab, 34 ref. English summary.

Descriptors: *Brazil, *Limnology, *Oligotrophic lakes, *Oxygen, *Oxygen deficit, Lakes, Oxygen requirements, Seasonal variation, Stratification, Vertical distribution.

The actual and relative oxygen deficits were com-puted from temperature and dissolved oxygen pro-files in Lake Dom Helvecio, Brazil during 1978. The areal hypolimnetic oxygen deficit was also computed in order to evaluate the trophic state of computed in order to evaluate the tropine state of the lake. In July, the actual oxygen deficit was around 2 mg O2/L in all the water column. It increased slowly with the settlement of thermal stratification and it attained 8 mg O2/L in the strattication and it attained a mg O2/L in the hypoliminetic zone. The relative oxygen deficits did not exceed 6.5 mg O2/L in the water column and were found from 20 m depth to sediment. The total actual oxygen deficit by lake surface unit ranged from 119.70 tons O2 (in September) to 163.28 tons O2 in May. The actual oxygen deficit

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by lake surface unit ranged from 1.37 mg O2/ by lake surface unit ranged from 1.37 mg O2/square cm in September to 2.37 mg O2/square cm in May. The areal hypolimentic oxygen deficits in Lake Dom Helvecio ranged from 0.56 to 1.30 mg/square cm/month. The trophic state of lake is almost all the year oligotrophic. A discussion on the vertical distribution of oxygen in the water column, on temperatures profiles and on the oxygen distribution and its action on the respiratory activities of the lacustrine organisms is given. The use of the areal hypolimmetic oxygen deficit as an index of lake trophy is stressed. (Author's abstract) stract) W90-06603

PRIMARY PRODUCTION OF PHYTOPLANK-PRIMARY PRODUCTION OF PHYTOPLANKTON OF CHASCOMUS POND, (PROV. BS.AS.,
ARGENTINA). CRITICAL EVALUATION OF
PHOTOSYNTHESIS VALUES OBTAINED BY
O2 AND 14C METHODS, (PRODUCCION PRIMARIA DEL FITOPLANCTON DE LA LAGUANA DE CHASCOMUS (PROV. DE
BUENOS AIRES, ARGENTINA). EVALUACION
CRITICA DE LOS VALORES DE FOTOSINTESIS OBTENIDOS POR LOS METODOS DEL
OX VALOR. O2 Y 14C). Universidad Nacional de La Plata (Argentina).

Omversitati Practonal La Fiata (Argentina). Inst. de Limnologia.

M. C. Romero, and P. M. Arenas.
Revista Brasileira de Biologia RBBIAL, Vol. 49,
No. 1, p. 303-308, February 1989. 3 fig. 2 tab, 17 ref. English summary.

Descriptors: *Aquatic productivity, *Argentina, *Limnology, *Phytoplankton, *Ponds, *Primary productivity, Bacteria, Bicarbonates, Carbon dioxde, Carbon radioisotopes, Photosynthesis, Season-

The primary production of the phytoplankton of Chascomus pond, in Argentina, was estimated with the dissolved oxygen and the assimilation of 14CO2 techniques, in the laboratory, at light saturation. The bicarbonate consumptions by the phy-toplankton was corrected by the excretion values, topiankton was corrected by the excretion values, anaplerotic uptake of CO2 by heterotrophic bacteria and for adsorption on suspended material. Gross production primary values fluctuated within 619.5 and 168.9 mg C/cubic m/hour, the net primary production with 56.8 and 168.9 mg C/cubic m/hour and the assimilation rate of CO2 was 576.3 (summer) and 93.8 (winter) mg C/cubic m/hour. (summer) and 93.8 (winter) mg C/cubic m/hour. The Steemann Neilsen technique gave an estimate of the primary production at an average of 21%. During the months of December, January and February those differences were only of the 8.6 rebruary those differences were only of the 8.6 and 1%, respectively, implying that carrying out the respective corrections, both methods equalize themselves. The CO2 assimilation rates fitted better with net primary production when the photosynthesis was low and with gross primary production when the photosynthesis was high. The photosynthesis showed an unimodal pattern, that increased in summer and diminished in winter, that increased in summer and diminished in winter, being the difference from June to February of 16% for the 14C method and 24% for the O2 method. (Author's abstract) W90-06604

INCORPORATION AND RELEASE OF PHOS PHORUS BY PLANKTONIC BACTERIA AND PHAGOTROPHIC FLAGELLATES.
Staatliches Inst. fuer Seenforschung und Fischereiwesen, Langenargen (Germany, F.R.).
K. Juergens, and H. Guede.

Marine Ecology Progress Series MESEDT, Vol. 59, No. 3, p 271-284, January 1990. 8 fig, 6 tab, 52

Descriptors: *Bacterial physiology, *Flagellates, *Lake Constance, *Limnology, *Phagotrophy, *Phosphorus, Biomass, Heterotrophic bacteria, La-

Phosphorus binding by heterotrophic bacteria was studied in mixed assemblages of lakewater bacteria in continuous culture under carbon and phospho-rus limitation and with different inocula (winter, summer) carbon:phosphorus ratios of the cultures varied from 80 to 100:1 under phosphorus limitation and from 30 to 60:1 under carbon limitation.

Resulting estimates of bacterioplankton phospho-Resulting estimates of bacterioplankton phosphorus content suggest that bacteria can be regarded as a significant phosphorus pool. This result was supported by measurements of the phosphorus content of bacterial communities in Lake Constance which showed that during summer on average 62% of the particulate and 40% of the total phosphorus in the euphotic zone was bound by bacteria. The partitioning of grazing to the regeneration of the bacterially bound phosphorus was evaluated in culture exerciments with mixed bacter. evaluated in culture experiments with mixed bacte-rial populations and isolated strains of heterotronanoflagellates under batch and two-stage phic nanoflagellates under oatch and two-stage continuous culture conditions. Phosphorus release due to grazing was most efficient when bacteria were carbon limited, leading to the regeneration of 50 to 90% of the bacterial phosphorus. With phosphorus-limited bacteria, regeneration efficiency was highly variable and could be reduced to less was nignly variable and could be reduced to less than 20%, depending on the kind of bacterial populations. Phosphorus release in the absence of grazers occurred in a variable amount only from bacteria under carbon starvation, parallel to a loss of biomass. (Author's abstract)

ADDITIONS TO THE DIATOMS OF VIRGIN-IA'S INLAND FRESH WATERS: LAKE BAR-CROFT, FAIRFAX COUNTY, VIRGINIA. George Washington Univ., Washington, DC.

George Washington Univ., Wa Dept. of Biological Sciences. R. G. Trumbull, and T. L. Hufford. Virginia Journal of Science VJSCAI, Vol. 40, No. 4, p 218-229, Winter 1989. 1 fig, 21 ref, 1 append.

Descriptors: *Diatoms, *Lake Barcroft, *Limnology, *Species composition, *Virginia, Distribution patterns.

From May 1979 through October 1979, benthic, epiphytic, and planktonic diatom samples were col-lected from Lake Barcroft, Fairfax County, Vir-ginia. A total of 177 samples were collected, with several hundred valves identified from each sample. From these observations, 179 diatom taxa representing 29 genera were identified. Previously, there were 367 recognized validly published diatoms from Virginia inland waters. The present study reports on 74 diatom taxa from Lake Barcroft not previously published for Virginia inland waters, thus raising the total taxa reported for Virginia to 441 for the Commonwealth. Species virginia to 441 for the Commonwealth. Species composition in an area is a useful baseline indicator to gauge effects of later developmental changes to the ecosystem resulting from industrial or residential development. (Author's abstract) W90-06653

REFINEMENT AND TESTING OF A LAKE WIND WAVE MODEL ON SEASONAL DATA. Atmospheric Environment Service, Downsview (Ontario). S. Clodman

Atmosphere-Ocean ATOCDA, Vol. 27, No. 3, p 588-596, September 1989. 2 tab, 3 fig, 8 ref.

Descriptors: *Lakes, *Model studies, *Waves, *Wind waves, Model testing, Seasonal variation, Testing procedures, Weather, Weather data collections, Wind.

A lake wind wave model was modified by increasing the forcing function, reducing the wave directional spreading, and correcting for static stability. This study was designed to improve the computation of wind wave characteristics on medium sized water bodies, such as the Great Lakes of North America, when a large, high appliet data set and America, using a large, high quality data set and tuning an existing numerical wind wave model for selected cases. The model results were compared selected cases. The model results were compared with data for several seasons and locations. It was found that the existing model, tuned for selected constant wind cases, is accurate and consistent for various weather situations and lakes. (Author's abstract) W90-06656

PHENOLOGY OF THE CLADOPHORA-STI-GEOCLONIUM COMMUNITY IN TWO URBAN CREEKS OF MELBOURNE,

Melbourne Univ., Parkville (Australia). Dept. of

Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 5, p 471-489, 1989. 3 tab, 5 fig, 48 ref. National Water Research Progra, project number 85/75.

Descriptors: *Algae, *Australia, *Periphyton, *Phenology, *Urban watersheds, Biomass, Cladophora, Ecology, Plant populations, Seasonal variation, Species composition, Streams, Vegetation ef-

Cladophora glomerata and Stigeoclonium tenue dominate lowland urban creeks in the Yarra River basin of south-central Victoria. In Darebin and Merri Creeks, Cladophora produces extensive mats in summer and autumn, and is mostly replaced by Stigeoclonium in winter and spring. Although Stigeoclonium in winter and spring, Although Stigeoclonium can grow all year round, it only out-competes Cladophora in winter and spring, when air temperaturers range between a maximum of less than 15 C and a nightly minimum of less than 10 C (water temperaturre less than 15 C, usually about 10 C). The seasonal composition and abundance of these macroalgae depend on temperature and on the severity of, and time since, the last floods, and the effect that these factors have on interspecific competition. Features of the microhabitat (e.g. photon irradiance, substratum stability and composition, and mean flow rates) determine the range of these variations. The biomass of both macroalgae fluctuates widely; this is due mainly to floods, these variations. The biomass of both macroargae fluctuates widely; this is due mainly to floods, which can remove almost the entire standing crop. In off-seasons, both species are maintained by small resilient plants or protected populations (in culture, plants remain viable after up to 6 months in complete darkness). Filaments of Cladophora readily produce zoospores and new vegetative growth fol-lowing dormancy. The prostrate thallus of Stigeo-clonium initiates new erect filaments before zoo-spores are produced. An understanding of the large local and seasonal variations in macroalgal biomass is essential for biological monitoring pro-grams. (Author's abstract) W90-06657

EFFECTS OF HYPOXIA ON OXYGEN CON-SUMPTION BY TWO SPECIES OF FRESHWA-TER MUSSEL (UNIONACEA:HYRIIDAE) FROM THE RIVER MURRAY.

Adelaide Univ. (Australia). Dept. of Zoology. F. Sheldon, and K.F. Walker.

Australian Journal of Marine and Freshwater Re-search AJMFA4, Vol. 40, No. 5, p 491-499, 1989. 3

Descriptors: *Australia, *Clams, *Limnology, *Oxygen depletion, *Oxygen requirements, *Rivers, Adaptation, Lentic environment, Lotic environment, Mussels.

environment, Mussels.

The mussel Alathyria jacksoni typically occurs in the main rivers of the Murray-Darling Basin and not in slow-flowing or standing waters. Conversely, Velesunio ambiguus is typical of billabongs and creeks and rarely occurs in big rivers except in the vicinity of impoundments. the exclusion of V. ambiguus from the main rivers probably reflects its weak anchorage, whereas the exclusion of A. jacksoni from billabongs may reflect its inability to withstand low levels of oxygen (hypoxia). At normal oxygen levels the mean rates of oxygen consumption for A. jacksoni and V. ambiguus are consumption for A. jacksoni and V. ambiguus are legative 0.75 (dry tissue) per hour to the negative one, respectively (a body-mass exponent of 0.75 was included in calculations of the mass-soccific oxygen consumption rate). When exposed to declining oxygen, A. jacksoni shows little or no regulatory ability, whereas V. ambiguus maintains a steady rate of oxygen consumption down to 65 torr. Under extreme hypoxia, a. jacksoni loses muscular tone but V. ambiguus closes its values and remains inactive. On removal from water a. jacksoni normal packsoni incurs a significant oxygen debt after 10 dasksoni incurs a signific remains inactive. On removal from water a, jack-soni incurs a significant oxygen debt after 10 days, but V. ambiguus shows no oxygen debt after 15 days. In general, animals adapted to lotic environments may need more oxygen, and may be more

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susceptible to hypoxia, than those adapted to lentic environments. (Author's abstract)

PALEOLIMNOLOGICAL EVIDENCE FOR THE RECENT ACIDIFICATION OF LYN HIR, DYFED, WALES.
Minnesota Univ., Minneapolis. Limnological Re-

For primary bibliographic entry see Field 5C. W90-06671

PALEOLIMNOLOGICAL RECONSTRUCTION OF RECENT ACIDITY CHANGES IN FOUR SIERRA NEVADA LAKES,

For primary bibliographic entry see Field 5C.
W90-06672

COMPARISON OF LAKES AND LAKE EN-CLOSURES WITH CONTRASTING ABUN-DANCES OF PLANKTIVOROUS FISH. Waterloo Univ. (Ontario). Dept. of Biology. A. Mazumder, W.D. Taylor, D.J. McQueen, D.R.S. Lean, and N.R. Lafontaine. Journal of Plankton Research JPLRD9, Vol 12, No 1, p 109-124, Jan 1990. 4 fig, 6 tab, 41 ref.

Descriptors: *Fish, *Fish food organisms, *Lakes, *Limnology, *Phytoplankton, *Predation, Aquatic life, Aquatic populations, Epilimnion, Phosphorus, Plankton, Secchi disks.

Experimental manipulations of planktivorous fish in large enclosures produced plankton communities comparable to those in lakes with contrasting abundances of planktivorous fish. Total epilimentic phosphorus (TP), its distribution among five size-classes of dissolved (less than 0.2 microm) and particulate phosphorous (PP 0.2-1, 1-20, 20-200 and greater than 200 micrometers), phosphate turnover time, water clarity (Secchi depth) and phytoplankton biomass (chlorophyll a) were measured for two summers in eight large enclosures where planktivorous fish (1 + yellow perch) and nutrients (N and P) were added in a 2 x 2 factorial design. These parameters were also measured in two meso-cutro-P) were added in a 2 x 2 factorial design. These parameters were also measured in two meso-eutrophic kettle lakes, Lake St. George and Haynes Lake, containing low and high abundances of planktivorous fish, one of which was the lake (St. George) containing the enclosures. Comparable data were also collected from three oligo-mesotrophic lakes in central Ontario. In both the enclosures and the lakes, intense planktivorous fish predation was associated with increased TP, decreased abundance of larger zooplankton and mesoplanktonic PP (greater than 200 micrometers), increased phosphate limitation (faster turnover time), increased chlorophyll a and reduced water clarity. Slope parameter, an index of dured water clarity. Slope parameter, an index of plankton size-spectrum, was correlated with phos-phate turnover time and Secchi depth among en-closures, and the data from all live lakes conclosures, and the data from all five lakes conformed to these empirical relationships. Fertilization of enclosures produced increased variability in the relationship among the variables. The 2 years of experiments produced qualitatively similar treatment effects, but the magnitude of the effects was not similar for all parameters. The authors suggest that the responses of plankton communities and associated parameters to planktivore predation that were observed in large experimental enclosures are basically similar to those in the lakes studied, and that enclosures are an important tool in understanding complex interactions in aquatic systems. standing complex interactions in aquatic systems. (Author's abstract)
W90-06673

NITROGEN BUDGET IN THE EUPHOTIC ZONE OF LAKE BIWA FROM SPRING TO **SUMMER, 1986.**

Nagoya Univ. (Japan). Water Research Inst T. Hama, K. Matsunaga, N. Handa, and M.

Journal of Plakton Research JPLRD9, Vol. 12, No. 1, p 125-131, January 1990. 1 tab, 1 fig, 23 ref.

Descriptors: *Cycling nutrients, *Euphotic zone, *Japan, *Lake Biwa, *Lakes, *Limnology, *Nitro-

gen, *Seasonal variation, Aquatic environment, Sediments.

The production rate of particulate nitrogen (PN) in Lake Biwa from March to June 1986 was calculated by monthly measurements of the proteinaceous nitrogen production rates. The 'new' production rate was estimated from the decrease in nitrate in rate was estimated from the decrease in nitrate in the euphotic zone; during this period (91 days) it was estimated as 93 milligram atoms/sq m and accounted for 20% of the 'total' PN production (460 milligram atoms/sq 2). This implies that approximately 80% of the PN produced might be recycled in the euphotic zone. The increase in PN in the euphotic zone during this period (27 mg atoms/sq m) accounted for 5.9% of the 'total' PN production. This indicates that the remaining 14% of PN produced in the euphotic zone was vertically transported. Sediment trap experiments at 30 m depth indicate that 8.1% of the PN produced in the beauthotic zone was researched as documented flux the euphotic zone was measured as downward flux at 30 m depth during the stagnation period. De-compositional loss of PN between 12.5 (bottom of the euphotic zone) and 30 m depth as estimated as 17 mg atoms/sq m. This was calculated on the basis of accumulation of ammonium, which accounted for 3.7% of the 'total' PN production. The flux from the euphotic zone thus accounted for 12% of the 'total' PN production, suggesting the validity of the production model. (Author's ab-

COMPOSITION OF PHOTOSYNTHETIC PRODUCTS IN LAKE BIWA, JAPAN; VERTICAL AND SEASONAL CHANGES AND THEIR RELATION TO ENVIRONMENTAL FACTORS. Nagoya Univ. (Japan). Water Research Inst. T. Hama, K. Matsunaga, N. Handa, and M. Takahashi.

Journal of Plankton Research JPLRD9, Vol. 12, No. 1, p 133-147, Jan 1990. 12 fig, 51 ref, Lake Biwa Research Institute, Shiga Prefecture grant.

Descriptors: *Japan, *Lake Biwa, *Lakes, *Lim-nology, *Metabolites, *Photosynthesis, Aquatic environment, Chromatography, Isotope studies, Ni-trogen, Phytoplankton, Productivity, Seasonal var-iation, Spectrometry, Temperature effects.

The seaonal and vertical changes in photosynthetic products were determined in Lake Biwa, which is the largest lake in Japan, by combined Carbon-13 and gas chromatography-mass spectrometry. The temperature dependence of the production rates differed with the combination of the production rates differed with the combination. temperature dependence of the production rates differed among organic compounds. The seasonal change in the protein specific production rate (SPR) showed a strong temperature dependence, indicating that phytoplankton growth rate was primarily governed by water temperature. In August and September, low protein SPR was, however, observed, probably due to low inorganic nitrogen concentration. Nitrogen deficiency in the late stagnation period was also suggested by high C.N ratios both in particulate matter and photosynthetic products. The glucose SPR did not show any significant correlation with water temperature, iric products. The glucose SPR did not show any significant correlation with water temperature, irradiance and inorganic nitrogen concentration. Highly variable glucose SPR might be due to high turnover of glucose, and vertical mixing in the mixed surface layer may be one of the most important factors causing variability of glucose SPR. (Author's abstract)
W90-06675

LOW-COST, PORTABLE FLOW CYTOMETER SPECIFICALLY DESIGNED FOR PHYTO-PLANKTON ANALYSIS. University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics. For primary bibliographic entry see Field 7B. W90-06676

EFFECT OF DETRITAL ADDITION ON THE DEVELOPMENT OF NANOFLAGELLATES AND BACTERIA IN LAKE KINNERET. Kinneret Limnological Lab., Tiberias (Israel).
O. Hadas, R. Pinkas, C. Albert-Diez, J. Bloem, and

T. Cappenberg.

Journal of Plankton Research JPLRD9, Vol. 12,

No. 1, p 185-199, January 1990, 7 fig. 5 tab. 56 ref.

Descriptors: *Bacteria, *Detritus, *Flagellates, *Israel, *Lake Kinneret, *Lakes, *Limnology, Cycling nutrients, Growth rates, Nitrogen, Phospho-

The effect of adding dissolved substrates derived from algal cells on the patterns of nutrient cycling and growth of bacteria, heterotrophic nanoflagelates (HNAN) and photoautotrophs was determined in samples of near-surface waters from Lake Kinneret. Supplementation of subtrates always resulted in an increased peak of HNAN numbers and had little effect on bacterial numbers. HNAN-mediated nutrient semiparalization of sitzeras of sitzeras of sitzeras constitutions. mediated nutrient remineralization of nitrogen and phosphorus was also stimulated. In light-incubated phosphorus was also stimulated. In light-incubated samples the remineralized nutrients were taken up by photoautotrophic cells. Maximum growth rates observed for HNAN ranged from 0.03 to 0.11/h, clearance rates for bacteria 1.1-7.3 nl/HNAM/h and remineralization rates 6.4-8.4 micrograms ntrogen/mg dry wt/h and 0.37-0.99 micrograms phosphorous/mg dry wt/h. (Author's abstract) W90-06677

HYDROCHEMISTRY AND POLLUTION STATUS OF SOME KASHMIR HIMALAYAN LAKES.

Kashmir Univ., Srinagar (India). Centre of Research for Development.
For primary bibliographic entry see Field 5B.

W90-06690

TRANSFORMATIONS OF NITROGEN FORMS IN EPILIMNION OF EUTROPHIC GLEBOKIE LAKE (MASURIAN LAKE DISTRICT, POLAND).

Polish Academy of Sciences, Lomianki. Inst. Eko-

H.M. Krupka.

Polskie Archiwum Hydrobiologii PAHYA2, Vol. 36, No. 1, p 29-96, 1989. 17 tab, 30 fig, 175 ref.

Descriptors: *Eutrophic lakes, *Limnology, *Nitrogen, *Nitrogen cycle, *Poland, Epilimnion, Nitrogen fixation, Stagnant water, Water tempera-

The seasonal, 24 hour and spatial (during summer stagnation) variability of the concentrations of nitrogen forms, as well as the relationships between these forms and environmental parameters were investigated in 1981-1983 in Glebokie lake, Poland. investigated in 1981-1983 in Glebokie lake, Poland. Throughout the year DON (dissolved organic nitrogen) was quantitatively dominant. Low 24 hour and spatial variability was displayed by: water temperature, oxygen, PH, chlorophyll a, total Nitrogen, DON, and crustacean and rotifers density; high variability was found for: PON (particulate organic nitrogen), NH4-N, NO2-N+NO3-N. Significant correlations (p less than or equal to 0.05) were found: I during the period of summer stagmawere found: 1. during the period of summer stagna-tion between DON and PON, as well as between tion between DON and PON, as well as between DON, and water temperature, oxygen, pH, NH4-N; 2. for individual 24-h observations, between DON and PON on 27 July, 3 August, 10 August, 21 September, and 4 October 1982, as well as between DON and chlorophyll a on 10 August, and 24 August 1982. In 1981 and 1982 (but not in 1983) nitrogen fixed from the atmosphere accounted for less than 1% of nitrogen sunlied by extered for less than 1% of nitrogen supplied by exter-nal sources. (Author's abstract) W90-06691

DETERMINATION OF THE METABOLIC AC-TIVITY OF HETEROTROPHIC BACTERIA ISOLATED FROM ESTUARINE GARDNO

Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Ecology and Protection of Environment. Z. Mudryk.

Polskie Archiwum Hydrobilogii PAHYA2, Vol. 36, No. 1, p 97-103, 1989. 3 fig, 1 tab, 31 ref.

Descriptors: *Estuaries, *Heterotrophic bacteria, *Lakes, *Metabolism, Amino acids, Glucose, Marine bacteria, Plankton, Respiration.

Group 2H-Lakes

Respirometric studies were performed to determine the metabolic activity of bacteria isolated from Gardno Lake, Poland. Planktonic bacteria from Gardno Cake, Poland. Planktonic bacteria displayed a higher respiratory activity than benthic bacteria. In terms of respiratory substrates casa-mino acids were metabolized most actively, and mino acius were metaoolized most actively, and glucose least actively. Casamino acids were utilized as an exogenous substrate by nearly all the bacteria studied, whereas glucose was metabolized by only 30-60% of strains. Halophilic bacteria utilized sodium acetate to a greater extent, taking up in its presence more oxygen than the nonhalophilic ones. The latter exhibited a higher metabolic active utility with serect to complex civile and players. ity with respect to casamino acids and glucose.
(Author's abstract)
W90-06692

EFFECT OF TEMPERATURE ON VERTICAL DISTRIBUTION OF ROTIFERS IN A MESO-TROPHIC LAKE.

Akademia Rolnicza, Lublin (Poland), Dent. of Zo-

Akademia Romicza, Luoin (roiand). Lept. of Zo-ology and Hydrobiology. S. Radwan, B. Popiolek, and A. Paleolog. Polskie Archiwum Hydrobiologii PAHYA2, Vol. 36, No. 1, p 113-121, 1989. 1 tab, 4 fig. 12 ref.

Descriptors: *Limnology, *Mesotrophic lakes, *Rotifers, *Temperature effects, Distribution, Epi-limnion, Plankton, Temperature, Vertical distribu-

The effect of temperature on vertical distribution The effect of temperature on vertical distribution of 14 species of planktonic rotifers in the mesotrophic Piaseczno Lake, was studied. During summer stagnation, in the epilimnion of the lake the following rotifer species occurred in greater numbers: Conochilus uniconis, Keratella cochlearis stecta, Polyarthra rulgaris. In the deeper water layers Kellicottia longispina and Filinia maior were more numerous. The remaining rotifer species were present in smaller numbers. They were nearly uniformly distributed within the whole water column or were somewhat more numerous in the epilimnion and metalimnion. (Author's abstract) nion and metalimnion. (Author's abstract)

DIFFERENTIATION OF THE HABITATS OF HYDROPSICHIDAE LARVAE (INSECTA: TRI-CHOPTERA) IN THE PASLEKA RIVER AS A RESULT OF AVOIDANCE OF TROPHIC COM-

PETITION.
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Inst. of Biology.

(Foland). Inst. of Biology. S. Czachorowski. Polskie Archiwum Hydrobiologii PAHYA2, Vol. 36, No. 1, p 123-132, 1989. 6 fig, 8 ref.

Descriptors: *Aquatic insects, *Caddisflies, *Ecological distribution, *Rivers, Habitats, Larvae, Poland, Stream biota.

Studies were performed in 1984-1986 at 11 sampling stations situated more or less uniformly along the Pasleka River (North-East Poland). Samples were collected at 1-month intervals, with the exception of winter when the river was covered with ice. More than 5000 larvae of four caddisflies speice. More than 5000 larvae of four caddistiles spe-cies of the family Hydropsychidae were collected. Changes in the numbers and frequency in the lon-gitudinal profile of the river, as well as the distri-bution in dependence of the nature of the bottom and as a function of the character of the bottom and of the season were analyzed. The species Hy-dropsyche pellucidula proved to be dominant both in the river and in all the microhabitats of the bottom. Retardation of the development of larvae bottom. Retardation of the development of larvae in the life cycle of Hydropsyche siltalai was found. Presumably this retardation results from avoidance of trophic competition with H. pellucidual larvae. The life cycle of Cheumatopsyche lepida proved to resemble that of Hydropsyche siltalai; however, the increase in larval size began already in autumn. The above-mentioned three species differ in the selection (for colonization) of bottoms characterized by dissimilar environmental conditions. It seems that the occurrence of Hydropsyche angustiseems that the occurrence of Hydropsyche angusti-pennis larvae in the Pasleka River is accidental; the larvae of this species either drift to the river from its small tributaries, or the Pasleka River is only a marginal environment for their occurrence. (Male-

W90.06695

REPRODUCTIVE BIOLOGY OF MYSTUS VIT-REPRODUCTIVE BIOLOGY OF MYSIUS VII-TATUS (BLOCH) (PISCES, BAGRIDAE), Bangalore Univ. (India). Dept. of Zoology. H.R. Sudha, and K. Shakuntala. Polskie Archiwum Hydrobiologii PAHYA2, Vol. 36, No. 1, p 133-148, 1989. 11 fig, 2 tab, 37 ref.

Descriptors: *Catfish, *India, *Life cycles, *Spawning, Climatic conditions, Fish populations, Lentic environment, Mature growth stage.

Mystus vittatus (bloch) is a freshwater catfish in-habiting the lentic habitats of Bangalore (South India). The reproductive cycle of a natural population of this fish studied in relation to the environmental factors. Females of the species attain first maturity at a minimum size of 85 mm. The stages of maturity at a minimum size of 65 min. The stages of maturity and the cycle of maturation of ovaries indicate that this species spawns once annually between August and September. The reproductive biology of this fish is largely dependent on the local climatic conditions of water temperature, photoperiod and precipitation. The reproduc-tive cycle of the fish varies in populations collected from different regions of India and combination of the above climatic factors seems to regulate the spawning periodically of the fish. (Author's abstract) W90-06696

PRODUCTIVE CAPACITY OF PERIPHYTON AS A DETERMINANT OF PLANT-HERBI-VORE INTERACTIONS IN STREAMS. Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

and Wildlife.

G. A. Lamberti, S. V. Gregory, L. R. Ashkenas,
A. D. Steinman, and C. D. McIntire.

Ecology ECOLAR, Vol. 70, No. 6, p 1840-1856,
December 1989, 6 fig. 3 tab, 8 ref. NSF grants
BSR-8318386 and BSR-8508356.

Descriptors: *Algae, *Aquatic plants, *Food chains, *Grazing, *Primary productivity, *Streams, Biomass, Ecosystems, Irradiance, Snails.

To investigate the influence of plant productivity on plant-herbivore interactions in stream ecosys-tems, the productive capacity of algal assemblages tems, the productive capacity of algal assemblages was varied by exposing periphyton to 3 levels of irradiance and 2 levels of grazing, Rates of primary production, algal biomass accumulation, and dominance by chlorophytes generally increased with higher irradiance. Ungrazed periphyton at low irradiance accumulated little biomass, which was further reduced by grazing smails (Juga silicula). At intermediate and high irradiance, snails delayed the accumulation of algal biomass but did not affect the final biomass. After 43 d, net primary production (NPP) at high irradiance was unaffected by grazing, whereas grazing increased NPP at both low and intermediate irradiance. Algal export increased with both irradiance and the presence of low and intermediate fractionance. Algal export in-creased with both irradiance and the presence of grazers and constituted a significant loss of plant biomass from the streams. Grazing by Juga de-layed algal succession and altered algal taxonomic structure and assemblage physiognomy by reduc-ing the relative abundance of erect and nonattached algae, while increasing the abundance of adnate diatoms. Snails grew slowly at low irradi-ance, due to scant food resources, but had high growth rates at intermediate and high irradiance, probably because food was not limiting. Assimilation efficiencies for snails varied from 40-70% and were highest at low irradiance. At low irradiance, were highest at low irradiance. At low irradiance, 90% of benthic production was harvested by grazers, whereas only 10% accumulated as atached biomass or was exported. At higher irradiances, <15% of primary production was harvested by grazers, and >85% persisted as attached algae or was exported. In these stream ecosystems, the biomass and production of grazers were influenced by abiotic constraints placed on algal productive capacity. The structure and metabolism of algal assemblages were affected, in turn by conalgal assemblages were affected, in turn, by con-sumptive demand of herbivores. The productive capacity of periphyton modified the nature and outcome of plant-herbivore interactions. This ca-pacity therefore has important implications for the operation of stream ecosystems. (Author's abstract)

W90-06704

RETENTION AND TRANSPORT OF NUTRI-ENTS IN A THIRD-ORDER STREAM; CHAN-NEL PROCESSES.

Geological Survey, Menlo Park, CA. Water Resources Div. sources Inv.
F. J. Triska, V. C. Kennedy, R. J. Avanzino, G.
W. Zellweger, and K. E. Bencala.
Ecology ECOLAR, Vol. 70, No. 6, p 1877-1892,
December 1989. 10 fig. 5 tab, 74 ref.

Descriptors: *Cycling nutrients, *Nitrates, *Peri-phyton, *Primary productivity, *Solute transport, *Streams, California, Chlorides, Chlorophyll a, Environmental tracers.

Chloride was injected as a conservative tracer with Chioride was injected as a conservative tracer with intrate to examine nitrate retention (storage plus biotic uptake) and transport in a 327-m reach of a third order stream draining a forested basin in northwestern California. Prior to injections, diel patterns of nutrient concentrations were measured under background conditions. Nitrate concentra-tion of stream water increased downstream, indition of stream water increased downstream, indi-cating that the reach was a source of dissolved inorganic nitrogen to downstream communities under background, low-flow conditions, despite uptake by photoautotrophs. At the onset of contin-uous solute injection over a 10-d period, timing the passage of the solute front indicated that storage dominated nitrate retention. Instantaneous concendominated nitrate retention. Instantaneous concentration differences at the base of the reach at hour 24 indicated that biotic uptake accounted for 13% of the nitrate amendment while hydrologic storage constituted 29%. Corrected for groundwater dilution (11.7%), saturation of the stream's channel and tion (11.7%), saturation of the stream's channel and hyporheic zones was not complete until 6.8 d of continuous injection. By day 3 nitrate retention was dominated by biotic processes. Biotic uptake was greatest during daylight hours, indicating retention by photoautotrophs, but also occurred during darkness. After 10 d of continuous injecduring darkness. After 10 d of continuous injection, mass balance calculations indicated that 29% of N (339 g) was retained from the total injected (1155 g), while the balance of injected nitrate was transported downstream. Storage of NO3-N was 117 g or 10 %, while biotic uptake was 222 g or 19%. Periphyton biomass on slides, chlorophyll a both on slides and on natural cobbles, and net community primary production all indicated a lag in periphyton response to nitrate amendment. Earliest indicators of a biotic response to nutrient amendment were decreases in both tissue C/N and epilithic resporation. (Author's abstract) epilithic respiration. (Author's abstract) W90-06705

RETENTION AND TRANSPORT OF NUTRI-ENTS IN A THIRD-ORDER STREAM IN NORTHWESTERN CALIFORNIA: HYPOR-

Geological Survey, Menlo Park, CA. Water Resources Div.

sources Div.
F. J. Triska, V. C. Kennedy, R. J. Avanzino, G.
W. Zellweger, and K. E. Bencala.
Ecology ECOLAR, Vol. 70, No. 6, p 1893-1905,
December 1989. 6 fig. 4 tab, 55 ref.

Descriptors: *Cycling nutrients, *Groundwater, *Nitrates, *Solute transport, *Streams, California, Chlorides, Chlorophyll a, Environmental tracers, Hyporheic zone, Wells.

Chloride and nitrate were coinjected into the surface waters of a third-order stream for 20 d to examine solute retention, and the fate of nitrate during subsurface transport. A series of wells (shallow pits) 0.5-10 m from the adjacent channel were sampled to estimate the lateral interflow of water. Two subsurface return flows beneath the wetted channel were also examined. The conservative tracer (chloride) was hydrologically transported to all wells. Stream water was >88 of flow in well all wells. Stream water was >88 of flow in wells <4 m from the wetted channel. The lowest percentage of stream water was 47% at a well 10 m perpendicular to the stream. Retention of solutes was greater in the hyporheic zone than in the channel under summer low-flow conditions. Nominal travel time (the interval required for chloride concentration to reach 50% of the plateau concen-

tration) was variable by well location, indicating different flow paths and presumably permeability differences in subsurface gravels. Nominal travel time was <24 h for wells <5 m from the wetted time was <24 h for weils <3 m from the weiter channel. Coinjected nitrate was not conservative. Two wells were significantly higher in nitrate-N than would be predicted from chloride, while four were significantly lower. Wells 2.0-4.0 m from the wetted channel tended to have higher nitrate con-centration than predicted, whereas nitrate sink lo-cations tended to have transport distances >4.3 m centration than predicted, whereas nitrate sink locations tended to have transport distances >4.3 m. The capacity of the hyporheic zone for transient solute storage and as potential biological habitat varies with channel morphology, bed roughness, and permeability. A conceptual model that considers the groundwater-stream water interface as the fluvial boundary is proposed. Emerging paradigms of the riverine network should consider the hyporheic zone and associated nutrient cycling as an integral component of fluvial structure and function. (Author's abstract)

RHEOTAXIS OF YOUNG ARCTIC GRAYLING FROM POPULATIONS THAT SPAWN IN INLET OR OUTLET STREAMS OF A LAKE. Montana Sta C. M. Kaya. ana State Univ., Bozeman. Dept. of Biology.

TAFSAI, Vol. 118, No. 5, p 474-481, September 1989. 2 fig, 2 tab, 22 ref.

Descriptors: *Arctic grayling, *Fish migration, *Lake fisheries, *Spawning, *Streams, Fish behavior, Genetics, Light intensity, Rheotaxis, Water currents, Water temperature.

Rheotactic behavior of young Arctic grayling Thymallus arcticus from two populations that spawn in inlet or outlet streams of a lake and from reciprocal crosses between the two populations was tested in an artificial stream at flow velocities up to 7 cm/s. Fertilized eggs from wild fish and the resulting young from the two populations were incubated and reared under identical conditions in a batchery before being tested. Voung fish from a hatchery before being tested. Young fish from both populations (referred to as inlet and outlet both populations (referred to as inlet and outlet young) were tested at the time of initial swim-up and at 11-41 d after swim-up. Outlet young had a significantly greater tendency to swim upstream than inlet young at temperatures of 10 (newly emerged but not older young), 12, and 16 C under both full (10.1-15.6 micromol/s/sq m) and dim (0.03-0.05 micromol/s/sq m) light conditions. Young from reciprocal crosses had intermediate responses at 12 and 16 C. However, both outlet and inlet young had similar, very weak, upstream responses when tested in darkness or (except for newly emerged young) at 10 C. Directional responses to water current appeared to be innate and genetically based but may be subject to environmental modification. (Author's abstract) W90-06739

OCEANIC AND RIVERINE INFLUENCES ON VARIATIONS IN YIELD AMONG ICELANDIC STOCKS OF ATLANTIC SALMON. Iowa State Univ., Ames. Dept. of Animal Ecolo-

gy.
D. L. Scarnecchia, A. Isaksson, and S. E. White Transactions of the American Fisheries Society TAFSAI, Vol. 118, No. 5, p 482-494, September 1989. 4 fig, 4 tab, 28 ref, append.

Descriptors: *Fish migration, *Fish populations, *Marine climates, *Rivers, *Salmon, Air temperature, Iceland, Seasonal variation, Spawning, Streamflow, Water temperature.

Data on yields of Atlantic salmon Salmo salar from 59 Icelandic rivers were analyzed with data on streamflows and sea and air temperatures, in an streamflows and sea and air temperatures, in an attempt to identify why some stocks exhibited more variable yields than others. A group of 24 northern and northeastern rivers, which flowed into seas with wide annual variations in climatic and oceanic conditions (as indicated by coastal sea and air temperatures), exhibited significantly greater variation in Atlantic salmon yields of both grilse and two-sea-winter fish (two winters at sea before first spawning) than the 31 western rivers, which

flowed into seas with more stable climatic and oceanic conditions. Yields were the most varied for stocks in the northeast, the region with the greatest annual variation in sea temperatures during spring and summer—the time when smolts migrate to the sea and begin to feed. Rivers with more variable seasonal streamflows also tended to have more variable two-sea-winter Atlantic salmon have more variable two-sea-winter Atlantic salmon yields (P < 0.05) but not more variable grilse yields (P > 0.05). However, variations in streamflows were less useful than variations in sea and air temperatures for explaining variations in yield. It is concluded that climatic and oceanic factors exert important influences on the variability in yield and abundance of Icelandic stocks of Atlantic salmon. (Author's abstract) W90-06740

SPAWNING HABITAT AND REDD CHARAC-TERISTICS OF SOCKEYE SALMON IN THE GLACIAL TAKU RIVER, BRITISH COLUMBIA

AND ALASKA.
National Marine Fisheries Service, Auke Bay, AK.

National Marine Pisheries Service, Auke Bay, AK. Auke Bay, Lab.
J. M. Lorenz, and J. H. Eiler.
Transactions of the American Fisheries Society
TAFSAI, Vol. 118, No. 5, p 495-502, September 1989. 4 fig, 1 tab, 30 ref.

Descriptors: *Aquatic habitats, *Fish migration, *Glacial streams, *Salmon, *Spawning, Flow velocity, Groundwater, River sediments, Taku River, Telemetry, Water temperature.

Spawning habitats of sockeye salmon (Oncorhynchus nerka) in the Taku River and its tributaries in British Columbia and Alaska were studied to deternine habitat use and redd characteristics in a glacial river stream. Radiotelemetry was used to track cial river stream. Radiotelemetry was used to track adult sockeye salmon to 26 spawning reaches, and 63 spawning sites were sampled for habitat characteristics. Over 40% of the salmon in the sampling area had a freshwater age of zero, and most of these spawned in main channels or off-channel areas. The availability of upwelling groundwater influenced habitat use in the main stem of the river; upwelling groundwater was detected in nearly 60% of the sites sampled in main-stem areas. Spawning sites with upwelling groundwater had lower water velocities and more variable substrate compositions than sites without upwelling ground. lower water veneties and more variance substrate compositions than sites without upwelling ground-water. Redds had 2-4 times more fine sediment than previously reported. The probability of use was greatest when substrate had less than 15% fine sediment, water velocity was between 10-15 cm/s, and intragravel temperature was between 4.5 and 6.0 C. (Author's abstract) W90-06741

DISTRIBUTION AND MIGRATION OF ADULT STRIPED BASS IN LAKE WHITNEY, TEXAS, Texas Parks and Wildlife Dept., Fort Worth. Fort Worth Research Unit.

worth Research Unit.

B. W. Farquhar, and S. Gutreuter.
Transactions of the American Fisheries Society
TAFSAI, Vol. 118, No. 5, p 523-532, September
1989, 4 fig. 4 tab, 22 ref. Federal Aid in Fish
Restoration Project F-31-R.

Descriptors: *Bass, *Fish migration, *Fish popula-tions, *Reservoirs, Dissolved oxygen, Fish behav-ior, Lake Whitney, Lakes, Population dynamics, Seasonal distribution, Seasonal variation, Telemetry. Texas. Water temperature.

Thirty adult (3.2-8.6 kg) striped bass Morone saxatilis were tagged with ultrasonic transmitters and tracked for up to 475 d in 9,510-hectare Lake Whitney, a Texas reservoir, to determine seasonal distribution, migration patterns, and water temperatures occupied. Striped bass distribution in summer was limited to an area near the dam, where they survived temperatures as high as 29.0 summer was limited to an area near the dam, where they survived temperatures as high as 29.0 C. Tagged fish generally were found in the coolest water available (27.0-29.0 C) that contained adequate dissolved oxygen (>4.0 mg/l) in summer and occupied the warmest water (7.4-8.8 C) in winter. For the rest of the year, the fish were distributed throughout available water temperatures. Beginning in autumn, most striped bass moved up the reservoir to and into the main tribu-

taries and remained there until spring, when they returned to the main reservoir. No spawning run up the main tributaries was observed in either of the two study years, possibly due to low inflows. Individual fish displayed a preference for certain areas to which they returned yearly. (Author's abstract) W90-06742

FACTORS AFFECTING FISH SPECIES RICHNESS IN ONTARIO LAKES.

Bayfield Inst., Burlington (Ontario). C. K. Minns.

Transactions of the American Fisheries Society TAFSAI, Vol. 118, No. 5, p 533-545, September 1989. 4 fig, 3 tab, 39 ref.

Descriptors: *Fish populations, *Lakes, *Ontario, *Species diversity, Canada, Hydrogen ion concen-tration, Limnology, Regression analysis, Statistical models, Water depth.

A large data set on Ontario lakes and their fish species was examined for evidence of the influence on species richness of regional, local, anthropogenic, and methodological factors. Analysis of regional species distributions and associations showed patterns consistent with species invasion into Ontario since the last period of glaciation. A comparison of local tracies richness green richness representations. tario since the last period of glaciation. A comparison of local species richness (mean richness among lakes) with regional richness pointed to a dominance of local over regional factors in determining lake species richness. A multiple regression model of species richness accounted for 48% of variance. Of the two regional factors included in the model, of the two regional factors included in the model, watershed species richness increased lake species richness and elevation decreased it. An increase in two local abiotic factors, lake area and mean depth, increased richness. Richness also increased depth, increased richness. Richness also increased with increasing pH, an anthropogenic factor, and increased in more recent survey years, an indicator of methodological effects. Analyses of mean species richness in relation to the presence or absence of individual species provided further evidence of sampling (methodological) effects. Overall, the results were consistent with the existing theory of island biogeography and its specific application to fishes in lakes. (Author's abstract) W90_06743

ACID NEUTRALIZATION IN LABORATORY SEDIMENT-WATER MICROCOSMS FROM ROCKY MOUNTAIN SUBALPINE LAK (IJSA).

Idaho National Engineering Lab., Idaho Falls. Center for Environmental Monitoring and Assessment.

For primary bibliographic entry see Field 5B. W90-06778

NUMERICAL STUDY OF THE INFLUENCE OF ENVIRONMENTAL CONDITIONS ON LAKE-EFFECT SNOWSTORMS OVER LAKE

South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences. For primary bibliographic entry see Field 2C. W90-06807

VARIATION IN ADIRONDACK, NEW YORK, LAKEWATER CHEMISTRY AS FUNCTION OF SURFACE AREA.

E and S Environmental Chemistry, Inc., Corvallis, OR.

For primary bibliographic entry see Field 2K. W90-06833

EFFECTS OF PARAMETER UNCERTAINTY ON LONG-TERM SIMULATIONS OF LAKE ALKALINITY.

Iowa Univ., Iowa City. Dept. of Civil and Envi-ronmental Engineering. For primary bibliographic entry see Field 5B.

Group 2H-Lakes

MODELING TRANSIENT STORAGE AND NITRATE UPTAKE KINETICS IN A FLUME CONTAINING A NATURAL PERIPHYTON COMMUNITY.

California Univ., Davis. Dept. of Chemical Engineering.

For primary bibliographic entry see Field 5B. W90-06860

HATCHING OF DIAPTOMUS STAGNALIS EGGS FROM A TEMPORARY POND AFTER A PROLONGED DRY PERIOD. Savannah River Ecology Lab., Aiken, SC. B. E. Taylor, G. A. Wyngaard, and D. L.

Mahone

Narchiv fuer Hydrobiologie AHYBA4, Vol. 117, No. 3, p 271-278, January 1990. 1 fig, 2 tab, 15 ref. DOE Contract DE-AC-09-76SROO819.

Descriptors: *Copepods, *Drought, *Limnology, *Ponds, *Reproduction, *South Carolina, Life history studies, Mortality, Savannah River Plant, Sea-

The calanoid copepod D. stagnalis is an important member of early season zooplankton communities in temporary ponds on the Savannah River Site in South Carolina. It is univoltine, producing only resting eggs. Rainbow Bay is a 1-ha pond that usually fills in winter and dries in spring or summer. Laboratory experiments and field observations during an extended dry period in 1988-1989 in Rainbow Bay demonstrated that some Diaptomus sees remain visible for more than 2 yr. Random productions and the stage of the in Raintow Bay demonstrated that some Diaptions useggs remain viable for more than 2 yr. Rapid hatching under suitable conditions suggests that embryogenesis is completed before the pond fills. Experiments with various temperature treatments in late spring, summer, and fall failed to induce hatching. It is hypothesized that some additional hatching. It is hypothesized that some additional condition, probably an extended exposure to moist substrate, is required to complete embryogenesis. Hatching did occur in subsequent winter laboratory experiments. Mortality of developed embryos during summer in the dry pond probably is severe and probably contributed to the substantial (approx. 10X) decline in the resting egg production from 1985-1989. (Author's abstract)

VERTICAL MIGRATION OF CHAOBORUS FLAVICANS (DIPTERA, CHAOBORIDAE): CONTROL OF ONSET OF MIGRATION AND MIGRATION VELOCITY BY ENVIRONMEN-

Munich Univ. (Germany, F.R.). Zoologisches Inst. I. Wagner-Dobler. Archiv fuer Hydrobiologie AHYBA4, Vol. 117, No. 3, p 279-307, January 1990. 8 fig. 5 tab, 41 ref. DFG FKZ JA-145/12-2.

Descriptors: *Light effects, *Limnology, *Midges, *Mountain lakes, *Vertical migration, Animal behavior, Buoyancy, Life history studies, Pressure.

Upward migration at dusk and downward migra-tion at dawn were studied in Chaoborus flavicans 4th-instar larvae in three small, mesotrophic to eutrophic peralpine lakes throughout 1 yr. Migration curves were obtained from quantitative echo-gram analysis. Onset of migration appeared to be triggered by the decrease of light intensity below a certain threshold value in upward migration. In downward migration, a certain rate of change of light intensity triggered the onset of migration. Onset of migration may require that both light intensity and rate of change of light intensity drop below a certain threshold value. Migration velocities below a certain threshold value. Migration velocity was independent of the rate of change in light intensity and the isophote velocity. The animals generally migrated more slowly than the isophotes, thus experiencing a decrease in light intensity during upward migration and a decrease in light intensity during downward migration. Neither temperature nor oxygen concentration exhibited. any detectable influence on migration velocity. By contrast, migration velocity was correlated negatively with light intensity in upward migration, independent of the other variables studied. Thus, high light intensities inhibited migration. Additionally, migration velocity was positively correlated with lake depth (hydrostatic pressure) in upward

as well as downward migration. Buoyancy adaptaas well as downward migration. Discovering suspice them in Chaoborus is known to be a very sensitive mechanism. Because relative change in hydrostatic pressure decreases with depth, less buoyancy adaptation is required at greater depths and may allow for larger migration speed of the larvae. This phenomenal models are not the control and the control are the control and the control and the control are the control and the control and the control are the control and the contro nomenon could account for the observed positive correlation between migration velocity and depth. (Author's abstract) W90-06877

SIMPLE SUBSAMPLING DEVICE FOR MA-CROINVERTEBRATES WITH GENERAL RE-MARKS ON THE PROCESSING OF STREAM BENTHOS SAMPLES.

Konstanz Univ. (Germany, F.R.). Limnological Inst.

For primary bibliographic entry see Field 7B. W90-06878

LIMNOLOGY OF THE DUMARESQ RESERVOIR: A SMALL MONOMICTIC UPLAND LAKE IN NORTHERN NEW SOUTH WALES,

LAKE IN NORTHERN NEW SOUTH WALES, AUSTRALIA. University of New England, Armidale (Australia). Dept. of Resource Engineering. R. J. Banens. Archiv fuer Hydrobiologie AHYBA4, Vol. 117, No. 3, p 319-355, January 1990. 12 fig. 4 tab, 39 ref.

Descriptors: *Australia, *Limnology, *Reservoirs, Algae, Bacteria, Depth variation, Drought, Du-maresq Reservoir, Eutrophic lakes, Floods, Geo-chemistry, Monomixis, Mountain lakes, Nutrients, Temporal variation.

Dumaresq Reservoir is a small, rural reservoir located at 1000 m on the tablelands of eastern Australia. The effects of drought, flood, and other factors on the temporal and depth variations of physical, chemical, and biological parameters were examined over a 4-yr period. The reservoir is eutrophic and is characterized by high levels of nutrients and algae, frequently dominated by bluegreens. Nutrient-chlorophyll analysis suggested that algal growth is N limited. Extensive weed beds and nutrient-rich organic sediments confirm its eutrophic character. It exhibits strong, prolonged, shallow stratification during summer, principally as a result of low clarity caused by organic color and high algal levels, and because of moderate winds, partial shelter, and the small fetch of the reservoir. The relatively large, anoxic, nutrientich hypolimmion regularly develops dense blooms of phototrophic sulfur bacteria. Nutrient levels and other water quality parameters are tied intimately to the prevailing hydrologic regime. The ion chemistry of the reservoir and its two inflowing streams is influenced largely by geology. A heat budget and annual stability data were determined for the reservoir. Prolonged shallow stratification and blooms of phototrophic sulfur bacteria, not commonly reported for Australian waters, are believed to be typical of many rural water-supply reservoirs. (Author's abstract)

FLUCTUATIONS IN SOME HYDROLOGIC FACTORS AND THE CONDITION INDEX OF ASPATHARIA SINUATA (BIVALVIA, UNIONACEA) IN A SMALL NIGERIAN RESERVOIR. Ilorin Univ. (Nigeria). Dept. of Biological Sci-

ences.
J. Blay.
Archiv fuer Hydrobiologie AHYBA4, Vol. 117,
No. 3, p 357-363, January 1990. 2 fig, 16 ref.

Descriptors: *Clams, *Limnology, *Mollusks, *Ni-geria, *Reservoirs, Calcium, Dissolved oxygen, Growth, Reproduction, Seasonal distribution, Silt, Temperature

The relationship between the fluctuations in some The relationship between the fluctuations in some environmental factors and the tissue condition of the tropical bivalve Aspatharia sinuata occurring in a small man-made Nigerian lake were investigated. The condition index (meat:shell ratio) was high in December-May, when the water was characterized generally by high temperatures, low silt content, high calcium and dissolved oxygen concentrations.

trations, high conductivities, and neutral/alkaline conditions. In June-November, the index was low and this seemed related to the slightly reduced temperatures, high silt content, low calcium and oxygen concentrations, low conductivities, and acid waters that occurred for most of the interval. acid waters that occurred for most of the interval, observations indicate that reproductive activity may have played a less significant role in determining the pattern of changes in the condition index of the population, presumably because high gonadal activity was maintained throughout the year. (Au-

STABILITY OF ALUMINUM SPECIES IN A NATURAL AUDIT SAMPLE: POSSIBLE APPLICATION AS A QUALITY CONTROL SOLU-

Lockheed Engineering and Sciences Co., Inc., Las egas, NV For primary bibliographic entry see Field 5B. W90-06932

ALUMINUM SPECIATION AND ORGANIC CARBON IN WATERS OF CENTRAL ONTAR-

Ontario Ministry of the Environment, Toronto. For primary bibliographic entry see Field 5B. W90-06938

ALUMINUM SPECIATION AND TOXICITY IN

UPLAND WATERS.
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 5B.
W90-06939

RADIONUCLIDE PARTITIONING ACROSS GREAT LAKES NATURAL INTERPACES. National Water Research Inst., Burlington (Ontar-io). Lakes Research Branch. For primary bibliographic entry see Field 5B. W90-06961

PREDICTING THE LONG-TERM VARIATIONS IN STREAM AND LAKE INORGANIC ALUMINIUM CONCENTRATIONS FOR ACIDIC AND ACID SENSITIVE CATCHMENTS.

Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 5B. W90-06978

ORGANIC GEOCHEMISTRY AND BRINE COMPOSITION IN GREAT SALT, MONO, AND WALKER LAKES.
Johns Hopkins Univ., Baltimore, MD. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2J. W90-07009

CONTAMINATION OF RURAL PONDS WITH PESTICIDE, 1971-83, ONTARIO, CANADA. Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab. For primary bibliographic entry see Field 5B. W90-07027

EFFECT OF HYDROMETEOROLOGICAL FACTORS ON SPREADING OF OIL PROD-UCTS IN RESERVOIRS. For primary bibliographic entry see Field 5B. W90-07045

PLANKTON, PRIMARY PRODUCTION AND SOME PHYSICO-CHEMICAL FACTORS OF TWO LAKES FROM BAIXADA MARANHENSE (PLANCTON, PRODUCAO PRIMARIA E ALGUNS FATORES FISICO-QUIMICOS DE DOIS LAGOS DA BAIXADA MARANHENSE). Universidade Federal do Maranhao, Sao Luis (Brazil). Lab. de Hidrobiologia. R. Barbieri, M. S. R. Ibanez, F. J. Aranha, M. M. F. Corrreia, and J. W. Reid.

Revista Brasileira de Biologia RBBIAL, Vol. 49, No. 2, p 399-408, May 1989. 2 fig, 6 tab, 15 ref. English summary.

Descriptors: *Aquatic life, *Brazil, *Lakes, *Lim-nology, *Plankton, *Primary productivity, Algal blooms, Physicochemical properties, Water chem-

The physico-chemical and biological characteristics of two 'varzea' lakes from the State of Maranhao, Brazil (Lago Acu and Lago de Viana) were studied. In Lago de Viana, samples were only taken during low water periods. For Lago Acu, the fluctuating water level is a consequence of the fluctuating water level of the Mearim River; for Lago de Viana of the Pindare River. The parameters measured were: temperature, water transparency, pH, electrical conductivity, alkalinity, dissolved oxygen, seston, primary production, chlorophyll a, as well as the composition of the phyto and zooplankton. Both lakes are shallow and turbid. The lack of thermal stratifications is probably due to wind action. The primary production turbid. The lack of thermal stratifications is probably due to wind action. The primary production and chlorophyll a results showed that Lago Acu is more productive and the primary production was migher during low water. Blooms of blue-greens were observed during both sampling periods. In Lago de Viana, diatoms were dominant. Representatives of the three principal groups of zooplankton (Rotifera, Copepoda and Cladocera) were found in both lakes, however, due to few available samples, it was not possible to clearly define a seasonal pattern. (Author's abstract) W90-07060

TEMPORAL AND SPATIAL PATTERNS IN LITTORAL-ZONE FISH ASSEMBLAGES OF A RESERVOIR (LAKE TEXOMA, OKLAHOMA-TEXAS, USA),

Diklahoma Univ., Kingston. Biological Station. F. P. Gelwick, and W. J. Matthews. Environmental Biology of Fishes EBFID3, Vol. 27, No. 2, p 107-120, February 1990. 4 fig. 5 tab, 48

Descriptors: *Fish populations, *Lake Texoma, *Littoral zone, *Spatial distribution, *Species composition, *Temporal distribution, Electrofishing, Evolution, Gizzard shad, Oklahoma, Seasonal distribution, Texas.

Fishery biologist have begun studying the ecosystem as a whole to try to better understand the needs of managed fish populations. The littoral-zone fish fauna of Lake Texoma reservoir was sampled by electrofishing from January through December 1986 to examine species abundance, species associations, and assemblage structure. Although total fish abundance differed significantly though total fish abundance differed significantly across seasons, only one common species (Dorosoma cepedianum) exhibited significant seasonal invovement in or out of the littoral zone. Overall littoral-zone assemblage structure (based on rank order of species abundance) was concordant across seasons and habitat types (vegetation, wood, open). However, within individual seasons and habitat types, assemblage structure was likely influenced by temporal and spatial differences in habitat availability and physicochemical conditions. Associability and physicochemical conditions. by temporal and spatial differences in habitat availability and physicochemical conditions. Associations characteristic of species in natural aquatic environments were not so well developed among species in this partially artificial, evolutionarily short-lived reservoir assemblage. Conditions related to water-level fluctuation appeared to deter the formation of persistent species associations and assemblage structure, especially in vegetation and open littoral zone habitats of this multi-species reservoir. (Author's abstract)

DAPHNIA AND TOXIC BLOOMS OF MICRO-CYSTIS AERUGINOSA IN BAUTZEN RESER-VOIR (GDR).

Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.

J. Benndorf, and M. Henning.

Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 74, No. 3, p 233-248, 1989. 4 fig, 4 tab, 41 ref.

Descriptors: *Acute toxicity, *Algal toxins, *Bioremediation, *Cyanophyta, *Daphnia, *Ecosystems, *Eutrophication, *Food chains, *Lake restoration, *Water pollution control, Biomass, East Germany, Phytoplankton, Reservoirs, Temporal variation.

Phytoplankton, Reservoirs, Temporal variation.

As a part of a whole-lake, long-term experiment in biomanipulation in the hypertrophic Bautzen reservoir (GDR) during three years (1984-1986) the dynamics of mouse-related LD50 of Microcystis aeruginosa was compared with the biomass development of this blue-green and the grazing pressure exerted by Daphnia galeata. Since the three summer averages of the biomass of Daphnia galeata revealed strong differences due to decreasing predation activity of fish from 1984 to 1986, the effects of different grazing pressure on Microcystis toxicity could be investigated under field conditions. Microcystis was nontoxic at the beginning of the growing season and developed high toxicity during its first strong biomass increase in summer in all three years. But this decrease of the LD50 together with the first biomass increase of the season is found in quite different periods in different years. The development of toxic Microcystis blooms seems to be promoted by a combination of five conditions: (1) Presence of a mixture of toxic and nontoxic Microcystis strains at the beginning of the growing season even if the portion of toxic strains is very low; (2) physical and chemical growth conditions which favor Microcystis over other phytoplankton; (3) high grazing pressure by zooplankton on edible food particles over a long period; (4) patchy distribution of the different Microcystis strains if nonselective filterers such as Daphnia dominate the zooplankton; and (5) absence of defense mechanisms of Microcystis against grazing which are not coupled with toxicity. These conclusions contribute to a better understanding of the possibilities and limits of in-lake eutrophication control by biomanipulation and emphasize the need to combine top-down and bottom-up control mechanisms in eutrophic and hypertrophic waters. (Author's abstract) W90-07096

HERBIVORES AND THE SPATIAL DISTRIBUTION OF THE PHYTOPLANKTON: II. ESTIMATING GRAZING IN PLANKTONIC ENVI-RONMENTS

Brookhaven National Lab., Upton, NY. Oceano-graphic Sciences Div.

For primary bibliographic entry see Field 2L.

W90-07097

SOME OBSERVATIONS ON THE IRRADIANCE AND CARBON FIXATION IN GRANE

Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab. G. Nygaard.

Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 74, No. 3, p 293-319, 1989. 13 fig,

Descriptors: *Carbon cycle, *Denmark, *Irradiance, *Lakes, *Limnology, *Net radiation, *Photosynthesis, *Phytoplankton, Carbon radioisotopes, Inhibition, Primary production.

Most Danish lakes are rich in bicarbonate ions and other vital ions. Grane Langso, however, is a sodium chloride lake with alkalinity values close to sodium chioride lake with aikaninty values close to zero and poor in potassium ions, nitrate, phosphate, and carbon dioxide. Photosynthetically active radiation (PAR) was registered daily in 0.25 meters and 11.25 meters in three years. Upwards irradiance of green light was 1% of downwards irradiance. Incubator carbon-14 experiments showed that the phytoplankton enhanced its carbon uptake that the phytopianton enabled is carron update substantially with increasing concentrations of the carrier carbon dioxide in the ampoules. Severe carbon limitation of photosynthesis occurred in spring and summer of 1961, where the real carbon fixation was only about 34% of that calculated by thation was only about 3-70 that cantaled by the usual procedure. Utilization of light and dis-solved inorganic carbon by the phytoplankton and its compensation depth was determined. Photoinhi-bition occurred down to 10-11 meters, and net primary production was nearly always positive in any depth down to the lake bottom. (Author's

W90-07099

PHOSPHORUS LOAD-CONCENTRATION RE-LATIONSHIP IN LAKE DAL, A HIGH ALTI-TUDE MARL LAKE IN THE KASHMIR HIMA-

Kashmir Univ., Srinagar (India). Dept. of Botany. M. Ishaq, and V. Kaul. Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 74, No. 3, p 321-328, 1989. 2 fig, 8

Descriptors: *Eutrophic lakes, *India, *Lake Dal, *Limnology, *Mountain lakes, *Nutrients, *Phosphorus, Glacial lakes, Kashmir Himalayas, Lake sediments, Phosphorus compounds, Residence time, Vegetative growth, Wastewater pollution.

The relationship between phosphorus concentration and estimated phosphorus load in Lake Dal, a marl lake, is described for the past decade. The concentration of this element in the lake system remained constant during this period although the phosphorus load increased about 40%. The constancy of phosphorus concentrations is attributed mainly to calcium carbonate-phosphorus interactions in water followed by the subsequent settling of phosphorus. The sediment is the lake's main phosphorus sink and holds about 99% of the total pool. The low total phosphorus orthophosphate ratio in the outflow channel compared with high level caused in the lake by the introduction of domestic sewage was found to be related to the low co-precipitation activity due to the low recophytic and macrophytic growth in the outflow channel. (Brunone-PTI) W90-07100 W90-07100

FIELD AND LABORATORY STUDIES ON NILE PHYTOPLANKTON IN EGYPT: III. SOME PHYSICAL AND CHEMICAL CHARAC-TERISTICS OF ASWAN HIGH DAM LAKE (LAKE NASSER).

Assiut Univ. (Egypt). Dept. of Botany. A. M. Ahmed, A. A. Mohammed, I. Springuel,

Descriptors: "Aswan Dam, "Egypt, "Lake Nasser, "Limnology, "Nile River, "Phytoplankton, "Reservoirs, "Seasonal variation, "Water chemistry, Oxygen content, Thermal stratification, Vegetative growth, Water transparency.

Seasonal, local and monthly vertical variations in physical and chemical characteristics of Aswan High Dam Lake (AHDL) were followed during the period from March 1982 to February 1984. The results show that distinct seasonal thermal variations exist. Similarly, thermal stratification was evident from late spring through early autumn. Oxygen content appeared to vary with the changes in hydrogen ion concentration value. Water transparency in the southern part was greatly reduced by the incoming silt-laden flood waters, especially in summer months. Consequently, nitrate-nitrogen and total residue increased considerably in the southern part during the summer. The recorded southern part during the summer. The recorded southern part during the summer. The recorded minimum nitrogen-concentration limited the growth of phytoplankton. Suspended and organic matter exhibited somewhat irregular variations at least during the period of this study. (Author's abstract) W90-07101

CENOLOGICAL RELATIONS OF MUD VEGE-TATION OF A HYPERTROPHIC LAKE IN TIS-ZAALPAR BASIN.

Jozsef Attila Univ., Szeged (Hungary). Dept. of Botany.

Tiscia TSCAB8, Vol. 23, p 3-12, 1989. 2 fig, 2 tab, 13 ref.

Descriptors: *Benthic flora, *Lake sediments, *Plant populations, *Species composition, *Water

Field 2-WATER CYCLE

Group 2H-Lakes

resources management, Hungary, Nutrients, Sedi-ments, Sheep, Tisza River, Tizaalpar Basin, Wastewater pollution.

The mud vegetation of a meander lake found in the The mud vegetation of a meander lake found in the area of the proposed Alpar Reservoir in Hungary is described. This lake was formed by the receding water after the flooding of the Tisa River had ceased. The water quality is influenced by untreated wastewater originating from a sheep fold built near the lake. The area is important as a newly identified habitat of Eleocharis ovata in the Great Hungarian Plain. The stands of Eleocharis ovata can be regarded as a considerably modified Eleocharis ovata. Hungarian Plain. The stands of Eleocharis ovata can be regarded as a considerably modified Eleocharito-Caricetum bohemicae association, influenced in its ecological structure by the high nutrient content of the lake sediment. Certain associations of plants, including Ranuculetum sclerati and Polygono-Bidentetum, are strongly competitive and influence the species composition of the meander lake vegetation. The building of the reservoir will cause the decay of this unique vegetation by destroying one of its few habitats in the Great Hungarian Plain. (Brunone-PTT)

CHANGES OF SOME PHYSICO-CHEMICAL CHANGES OF SOME PHYSICO-CHEMICAL AND SAPROBIOLOGIC CHARACTERISTICS IN THE LOWER COURSE OF THEISS IN THE PERIOD 1980-1986. Novi Sad Univ. (Yugoslavia). Inst. of Biology. K. Kojcic, V. Pujin, and R. Bugarski. Tiscia TSCAB8, Vol. 23, p 21-28, 1989. 4 fig, 1 tab,

7 ref.

Descriptors: *Biochemical oxygen demand, *Dam effects, *Flow rates, *Physicochemical properties, *Tisza River, *Water quality, Ammonium, Hungary, Oxygen, Pollution index, Water currents.

Research on the lower course of the Tisa River (Theiss) in 1980-1986 shows certain changes in the (Theiss) in 1980-1986 shows certain changes in the physicochemical and saprobiologic characteristics of the river water. The erection of a dam at Novi Becej and on the Danube (Djerdap) has slowed the current in the lower course of the river. Dissolved oxygen levels dropped 7% and the biochemical oxygen demand increased approximately 10%. The concentration of ammonium ion increased, especially in the winter months. The pollution index up to 1983 was about constant, but in recent months shows some worsening. (Author's abstract) shows some worsening. (Author's abstract) W90-07111

PHOSPHATASE ACTIVITY OF WATER AS A PARAMETER OF THE RIVER TISA WATER MONITORING.

Novi Sad Univ. (Yugoslavia). Inst. of Biology. For primary bibliographic entry see Field 5A. W90-07112

DOMINANT BACTERIOFLORA IN THE WATER OF THE RIVER TISA AND THE WATER OF THE REVER 135 AND THE MRTVA TISA (YUGOSLAVIA). Novi Sad Univ. (Yugoslavia). Inst. of Biology. For primary bibliographic entry see Field 5A. W90-07113

DEVELOPMENTS IN THE COMPOSITION OF BIOCENOSIS IN THE LOWER TISA RIVER (YUGOSLAVIA) CAUSED BY HYDROLOGI-CAL CHANGES.

Novi Sad Univ. (Yugoslavia). Inst. of Biology. V. Pujin.

Tiscia TSCAB8, Vol. 23, p 43-49, 1989. 4 fig, 16

Descriptors: *Dam effects, *Species composition, *Tisza River, Ammonia, Benthic fauna, Biochemical oxygen demand, Fish, Flow rates, Oligochaetes, Oxygen saturation, Rotifers, Seasonal variation, Water currents, Zooplankton.

The construction of the Hydroelectric Power Plant on the Danube and the dam on the Tisa at Novi Becej, Yugoslavia, have slowed the flow of the river, causing changes in the physical and chemical properties of the river water and in spe-cies composition of the biocenosis. The oxygen

saturation level decreased, while biochemical oxygen demand and the level of ammonia ions increased, particularly in winter months. In the zooplankton, the number of rotifer species, as well zooplankton, the number of rotifer species, as well as the population densities of the dominant species, increased. In the bottom fauna, oligochaetes, represented by ten to sixteen species of the Naididae and Tubificidae families are dominant. The species composition of the ichthyofauna has shifted to less sterlet and more predatory fishes and carp. The species diversity of the fish community has decreased. (Author's abstract)

GROWTH OF CARP (CYPRINUS CARPIO L.) IN THE KISKORE STORAGE LAKE. Lajos Kossuth Univ., Debrecen (Hungary). For primary bibliographic entry see Field 8I. W90-07122

ORIENTATION OF ZOOPLANKTON TO THE OXYCLINE IN BIG SODA LAKE, NEVADA. Nevada Univ., Las Vegas. Dept. of Biological

M. A. Bozek.
Great Basin Naturalist GRBNAR, Vol. 49, No. 4, p 535-539, October 1989. 3 fig, 17 ref.

Descriptors: *Crater Lake, *Irrigation effects, *Limnology, *Meromictic lakes, *Nevada, *Zooplankton, Anoxic conditions, Aquatic populations, Aquatic productivity, Bacteria, Water level.

Big Soda Lake is an ectogenic meromictic crater lake located near Fallon, Nevada. A remnant of pluvial Lake Lahontan, Big Soda Lake has undergone considerable change because irrigation of the surrounding area has increased the water table and lake level, thus resulting in reduced salinity and increased chemocline depth. Zooplankton in Big Soda Lake, were sampled in October 1982 to determine sergies convecition and waterial distributions. Soda Lake, were sampled in October 1922 to de-termine species composition and vertical distribu-tion relative to the oxycline. Moina hutchinsoni was most abundant in the epilimnion, but prior to migrating into the anoxic hypolimnion, it aggregat-ed at the oxycline. Brachionum placatilis was most abundant below the oxycline. Concentrations of Brachionum and Moina near the oxycline correbrachfoldin and whoma leaf the Oxycline Corre-sponded with peaks in bacterial productivity found by previous investigators. However, further inves-tigation should be conducted to verify feeding by zooplankton primarily in the anoxic hypolimnion. (Mertz-PTT)

COEXISTENCE OF TWO SPECIES OF SUCKER, CATOSTOMUS, IN SAGEHEN CREEK, CALIFORNIA, AND NOTES ON THEIR STATUS IN THE WESTERN LAHON-

California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 2E.
W90-07141

RESPONSE OF NESTING WATERFOWL TO FLOODING IN GREAT SALT LAKE WET-

Utah State Univ., Logan. Dept. of Fisheries and For primary bibliographic entry see Field 6G. W90-07142

MOURNING DOVE USE OF MAN-MADE PONDS IN A COLD-DESERT ECOSYSTEM IN

South Dakota State Univ., Brookings. Dept. of Wildlife and Fisheries. F. P. Howe, and L. D. Flake. Great Basin Naturalist GRBNAR, Vol. 49, No. 4, p 627-631, October 1989. 2 fig, 13 ref.

*Adaptation, *Artificial ponds, erts, *Idaho, *Wildlife habitats, Descriptors: *Birds, *Deserts, *Io Doves, Ponds, Zenaida.

Because many natural water sources are desiccated during the summer, mourning doves (Zenaida ma-

croura) in the cold-desert environment of the Idaho National Engineering Laboratory depend primarily on man-made ponds for drinking water. Mourning doves in the cold-desert ecosystem use man-made ponds for watering, feeding, gritting, loafing, and courting. Diurnal pond use by doves peaked in the morning and evening. Monthly dove use of ponds fluctuated slightly during the sumers of 1984 and 1985. Pond size, pH, and shoreline characteristics had little association with the intensity of pond use by doves; but geographic isolation of ponds was weakly associated with number of arrivals during that period. It is concluded that man-made water sources are important number of arrivals during lant period. It is con-cluded that man-made water sources are important in areas where water availability may limit mourn-ing dove productivity and abundance. It is suggest-ed that mourning dove arrival rates could be used as a population index in cold-desert areas. (Mertz-PTT) W90-07143

INDEPENDENT AND INTERACTIVE EFFECTS OF SNAIL GRAZING AND NUTRIENT ENRICHMENT ON STRUCTURING PERIPHY-TON COMMUNITIES.

Bowling Green State Univ., OH. Dept. of Biologi-

J. C. Marks, and R. L. Lowe. Hydrobiologia HYDRB8, Vol. 185, No. 1, p 9-17, November 1989. 3 fig, 2 tab, 24 ref.

Descriptors: *Algae, *Chlorophyta, *Cyanophyta, *Diatoms, *Limnology, *Nitrogen, *Periphyton, *Phosphorus, *Snails, *Species composition, Aquatic ecosystems, Aquatic life, Elimia, Goniobasis, Grazing, Michigan, Navicula, Oedogonium, Stigeoclonium.

The independent and interactive effects of nutrient The independent and interactive effects of nutrient enrichment and snail grazing on structuring periphyton communities in a northern temperate lake (Douglas Lake, Michigan) were investigated. Nutrient releasing substrates and grazer enclosures were used to simultaneously manipulate nutrient availability and herbivory. Periphyton was allowed 18 days to accrue before grazers (Elimia livescens e Goniobasis livescens) were introduced. Addition of nitrogen and phosphorus caused a significant increase in hisyolume, whereas grazing Addition of nitrogen and phosphorus caused a significant increase in biovolume, whereas grazing had no significant effect on biovolume but resulted in a shift in species composition. Four taxa were largely responsible for the increase in biovolume on the nutrient enriched substrates: Oedogonium sp., Stigeoclonium tenue, Navicula radiosa var. radiosa and Navicula radiosa var. tenella. By the radiosa and Navicula radiosa var. tenella. By the 28th day, nutrient enrichment caused a shift from a community dominated by diatoms (Bacillariophyceae) to a community dominated by green algae (Chlorophyceae). Blue green algae (Myxophyceae) maintained an equal proportion in high and lownutrient regimes. Grazing had a more pronounced effect on altering community composition on the nutrient enriched substrates than on the unenriched substrates. Grazing caused a decrease in diversity and an increase in dominance by green algae on the nutrient enriched substrates. The relative bio-volume of green algae increased from 64% to 93% volume of green algae increased from 64% to 93% volume of green algae increased from 64% to 93% on grazed substrates, due to the significant increase in relative abundance of Stigeoclonium tenue. This taxon has both prostate basal cells and erect filamentous cells. The ratio of basal:filamentous cells increased from 4.7 to 5.2 with grazing, suggesting that the heretotrichous growth form of Stegeoclonium tenue is adapted to grazing by virtue of the basal cells which are able to adhere to the substratum and resist being grazed. (Author's abstract) stract)

SIGNIFICANCE OF A LOW OXYGEN LAYER FOR A DAPHNIA POPULATION IN LAKE YUNOKO, JAPAN.

National Inst. for Environmental Studies, Ibaraki (Japan).

(Apani).
T. Hanazato, M. Yasuno, and M. Hosomi.
Hydrobiologia HYDRB8, Vol. 185, No. 1, p 19-27,
November 1989. 6 fig, 38 ref.

Descriptors: *Daphnia, *Japan, *Lake stratifica-tion, *Lakes, *Limnology, *Oxygen, *Seasonal

variation, *Temperature effects, *Thermal stratifi-cation, Anoxic conditions, Population dynamics, Predation, Reproduction.

Population dynamics and vertical migration of Daphnia longispina in Lake Yunoko, Japan were studied. The Daphnia population was small in spring and early summer, probably because of high predation pressure by fish. The population grew in midsummer, when thermal stratification developed and the dissolved oxygen became very low in the deeper layer of the hypolimnion. In this season, adults of D. longispina concentrated in the daytime mean the lake hottom where fish were absent benear the lake bottom, where fish were absent be-cause of the anoxic conditions, but ascended at cause of the anoxic conditions, but ascended at night to the upper layer of the hypoliminon, where food was most abundant. The low oxygen layer near the bottom kept out the predators and protected Daphnia from predation, and consequently contributed to the build-up of its population. However, the low oxygen layer was unfavorable for reproduction of Daphnia, as reflected in the low reproduction of Daphnia, as reflected in the low egg ratio and high percentage of males in the population. The population decreased in the fall, when thermal stratification disappeared and preda-tion pressure seemed to increase. (Author's ab-stract) W90-07146

ASSESSMENT OF SHORT-TERM DEPLETION OF STREAM MACROINVERTEBRATE BENTHOS BY DRIFT. Pittsburgh Univ., PA. Dept. of Biological Sci-

ences.
M. A. Wilzbach, and K. W. Cummins.
Hydrobiologia HYDRB8, Vol. 185, No. 1, p 29-39,
November 1989. 5 fig. 4 tab, 46 ref. National
Science Foundation grant BRS-8606549 and U.S.
Department of Energy grant

Descriptors: *Aquatic insects, *Macroinverte-brates, *Maryland, *Riffles, *Streams, Aquatic drift, Benthic fauna, Dolophilodes, Mortality, Tan-

Emigration of drifting macroinvertebrates from a stream riffle that was blocked for one week from stream riffle that was blocked for one week from immigration by upstream colonists was studied to determine if it significantly reduced the abundance of drift collected from the tail of the riffle. The head of a 9 m long riffle of a 2nd order stream in Maryland (Piney Run) was blocked from incoming drift by a 250 micrometer mesh weir. Upstream immigration of invertebrates into the riffle was largely prevented by a partition placed at the tail of the riffle which held the drift nets. Benthos and drift smaller was reduced from the riffle which held the drift nets. Benthos and drift samples were collected from the riffle prior to weir placement and following its removal, and drift was collected at dusk on each day. No differ-ence in drift or in benthic abundance between the beginning and end of the study was observed. This beginning and end of the study was observed. This is largely attributed to recruitment of immature insects (primarily hatching of eggs present at the outset), particularly of Dolophilodes distinctus and species of Tanytarsini, from within the riffle. Re-sults suggest that recruitment of riffle species is of suits suggest that recruitment of riffle species is of sufficient magnitude to more than compensate for short-term riffle depletion due to drift. Samples of drifting and non-drifting (benthic) animals were held without food for 12 hours after collection and mortality within each group was determined. The mortality of drifting animals was three-fold that of benthic animals. (Author's abstract)

DIATOM SPECIES COMPOSITION ALONG A THERMAL GRADIENT IN THE PORTNEUF

HERMAL EARDIENT IN THE PORTNEUF RIVER, IDAHO, USA. Idaho State Univ., Pocatello. Dept. of Biology. D. K. Vinson, and S. R. Rushforth. Hydrobiologia HYDRB8, Vol. 185, No. 1, p 41-54, November 1989. 6 fig, 4 tab, 54 ref.

Descriptors: *Algae, *Diatoms, *Idaho, *Rivers, *Temperature effects, *Thermal springs, *Warm springs, Achnanthes, Gomphonema, Nitzschia, springs, Achnanthes, Gomphonema, Population density, Temperature gradient.

Most research dealing with algae of thermal sys-tems has addressed blue-green algae and bacteria.

Few studies have investigated diatom species di-versity along thermal gradients. This study was conducted on the Portneuf River, Caribou county, Idaho, where a small warm spring with a discharge of .0025 cubic m/sec enters the river near Deer Canyon. Glass microscope slides were placed to canyon. Onass microscope sinces were placed to span a range of temperatures in and around a warm spring in the Portneuf River in the winter of 1987. Diatoms were allowed to colonize these slides for 8 weeks. Analysis of slides revealed that maximum species diversity and species richness were reached between 25 and 30 C. Analysis also showed that certain diatom taxa were stenothermal, showing distinct preferences for various temperatures while others were eurythermal. Achnanthes lanceolata and Gomphonema parvulum were present at all temperatures, but preferred the 14-22 C range. Nitzschia frustulum var. perminuta occurred at all temperatures, but was most abundant at 39 C. As a group, Achnanthes spp. preferred cooler tempera-tures, Cocconeis spp. and Nitzchia spp. favored warmer temperatures, and Navicula spp. were most abundant only in the 8-12 C range. (Mertz-PTT) W90-07148

FLUCTUATIONS IN THE COMMUNITY COM-POSITION OF WATER-COLUMN PROTOZOA IN TWO SOUTHEASTERN BLACKWATER RIVERS (GEORGIA, USA).

RIVERS GEORGIA, USA).
Georgia Univ., Athens. Inst. of Ecology.
L. A. Carlough.
Hydrobiologia HYDRB8, Vol. 185, No. 1, p 55-62,
November 1989. 3 fig. 34 ref. National Science
Foundation grant BSR-8406631.

Descriptors: *Aquatic habitats, *Georgia, *Popula-tion dynamics, *Protozoa, *Stream biota, Animal populations, Benthos, Environmental effects, Pop-ulation density, Species diversity, Swamps.

Protozoan population dynamics of two southeast-Protozoan population dynamics of two southeast-ern blackwater rivers in Georgia were examined: the sixth order Ogeechee River and fourth order Black Creek. The density and composition of the protozoan community was assessed by counting the protozoans and separating them into size class-es. Particularly abundant flagellate types (bloom forms) and ciliates were enumerated separately. Protozoan density in these blackwater rivers is high. Observations during a two week and a ten month census showed that the rate of community change is rapid and that the range in diversity is month census snowed that the rate of community change is rapid and that the range in diversity is great. A backwater site showed the highest percentage of bloom forms, while the main channel sites of Black Creek and the Ogeechee River had fewer bloom forms. Rapid increases in density fewer bloom forms. Rapid increases in density during a two week microcosm study were attributed to isolation of the water-column from filter-feeders, the benthos, and different source areas. An analogous situation may exist in the low order swamp streams and backwater habitats where many dense blooms occur. The high protozoan population densities observed were partially due to rapid changes in the physical characteristics of the environment, reactions of the protozoa to such changes, growth in the swamp tributaries and backwater areas, subsequent washing into the backwater areas, subsequent washing into the river, and further growth as the water moves toward the sea. (Author's abstract)

EFFECT OF LONG POOLS ON THE DRIFT OF MACRO-INVERTEBRATES IN A MOUNTAIN

STREAM.
Montana State Univ., Bozeman. Dept. of Biology.
J. C. Martin, and A. W. Knight.
Hydrobiologia HYDRB8, Vol. 185, No. 1, p 63-70,
November 1989. 6 fig. 9 ref.

Descriptors: *Aquatic drift, *Aquatic habitats, *Aquatic insects, *Benthic fauna, *California, *Ma-croinvertebrates, *Mountain streams, Mayflies, Midges, Population dynamics, Stoneflies, Streams.

Macroinvertebrate drift was measured entering and leaving two pools on the Middle Fork of the Cosumnes River, a third order California stream. Drift rates for Baetis spp., Chironomidae, Simulium spp., Capniidae and total drift were calculated. Significant differences in the numbers of orga-

nisms entering the two pools were found for Baetis, Chrionomidae, and Capniidae. Comparisons of drift rates at the upstream and downstream ends of each pool showed that the abundance of Chiron-omidae, Simulium, Capniidae and total drift changed in different directions across the pools. changed in different directions across the pools. The numbers of organisms leaving the two pools, however, were not significantly different for Baetis, Simulium, Capniidae and total drift. These findings lead us to hypothesize that long pools act findings lead us to hypothesize that long pools act as barriers, not filters, to stream macroinvertebrate drift. The composition of drift leaving the pools in this experiment appeared to be controlled by the composition of the benthic habitat at the tail of the pool and not by the composition of upstream drift entering the pools. (Author's abstract) W90-07150

UPSTREAM-DOWNSTREAM MOVEMENTS OF AQUATIC INVERTEBRATES IN A ROCKY MOUNTAIN STREAM.

Colorado State Univ., Fort Collins. Dept. of Ento-

Hotogy, E. A. Bergey, and J. V. Ward. Hydrobiologia HYDRB8, Vol. 185, No. 1, p 71-82, November 1989. 5 fig, 4 tab, 30 ref.

Descriptors: *Aquatic drift, *Aquatic habitats, *Aquatic insects, *Colorado, *Mountain streams, *Stream biota, Benthic fauna, Benthos, Caddisflies, Invertebrates, Mayflies, Population dynamics, Rif-

Simultaneous collections of drift and organisms moving either upstream or downstream in associa-tion with the substrate were made using a specially tion with the substrate were made using a specially designed sampler. Samples were taken in a diel series on six dates over an annual cycle along a transect across a single riffle of Buckhorn Creek, a Colorado foothills stream. In addition to longitudinal movements, taxonomic composition and diel periodicity were evaluated. The insect-dominated fauna showed a net downstream displacement periodicity were evaluated. The insect-dominated fauna showed a net downstream displacement. Only the caddisflies Helicopsyche borealis and Hesperophylax occidentalis exhibited net upstream movement, primarily a result of low drift frequencies. The taxonomic composition of moving invertebrates differed from that of the benthos. Drift resembled downstream moving substrate-associated invertebrates in composition, but differed from that of the upstream directed fauna. Taxa collectively exhibited four types of diel patterns: (1) similar downstream (drift and substrate-associated movements) patterns, which generally differed from the upstream pattern; (2) similar benthic (upstream and downstream) patterns, which differed from the upstream patterns; make higher than the difference of the drift; (3) aperiodic patterns; and (4) stream and downstream) patterns, which differed from that of drift; (3) aperiodic patterns; and (4) independent patterns for each type of directional movement. Analysis of size classes based on head capsule width for the mayfly Baetis tricaudatus showed significantly smaller size in stationary individuals compared with moving individuals in the population and revealed that nymphs moving during the day were smaller than those moving at night. (Author's abstract) W90-07151

NEW BATHYMETRIC MAP BASED ON ECHO-SOUNDING AND MORPHOMETRICAL CHARACTERIZATION OF THE LAKE OF BANYOLES (NE-SPAIN).

BANTULES (VESTAIN), Institut d'Ecologia Aquatica, Gerona (Spain). R. Moreno-Amich, and E. Garcia-Berthou. Hydrobiologia HYDRB8, Vol. 185, No. 1, p 83-90, November 1989. 3 fig. 4 tab, 15 ref.

Descriptors: *Bathymetry, *Hydrologic maps, *Karst, *Lakes, *Limnology, *Mapping, *Spain, Sinkholes, Subsurface mapping.

The lake of Banyoles is situated at 172 m above sea level, on a karstic system, adjacent to the city of Banyoles 17 km from Girona, in NE Spain. The lake is a flooded polje consisting of independent basins (dolines) which were joined following an elevation of water level. In addition, the Lake of Banyoles has a mixed tectonic-karstic origin, based on the presence of a fault. Water entry is basically subterranean. In the new bathymetric map, the lake configuration is made up of 6 basins, with 12

Group 2H—Lakes

areas occupied by suspended mud corresponding at least to 13 bottom springs. Several differences were observed from the old map. The authors suggest that the observed differences with the old map can be attributed to a low survey intensity. There is also the possibility that some of the differ-ences have been originated from recent sinkings, after the old map design, proved by the formation of other small lakes since compilation of the old map in 1980. (Mertz-PTT) W90-07152

LIMNIC MICRO-CRUSTACEANS TROPHIC DEGREE. AND Uppsala Univ. (Sweden). Limnologiska Institu-

tionen.
B. Berzins, and J. Bertilsson.
Hydrobiologia HYDRB8, Vol. 185, No. 2, p 95100, November 1989. 3 fig, 13 ref.

Descriptors: *Crustaceans, *Limnology, *Microorganisms, *Phosphorus, *Plankton, *Pollution index, *Trophic level, Benthic fauna, Conductivity, Eutrophy, Oligotrophy, Periphyton, Suspended sediments, Sweden.

During the years 1945-1982 an extensive collection During the years 1945-1982 an extensive collection of planktonic, periphytic and benthic microzoans from different types of waters in south and central Sweden was collected. The material also includes several abiotic factors, consisting of about twenty parameters. A computerized compilation of the microcrustaceans and their relation to trophic degree is presented. The more frequent species were ranked according to phosphorus content, electrolytic conductivity and content of suspended matter. Correlations were obtained between center. electrolytic conductivity and content of suspended matter. Correlations were obtained between occur-rence of species and each environmental factor to determine possible correlations with trophic degree. With few exceptions, species indicating oligotrophy are found at lower factor values and those indicating eutrophy at higher values con-cerning all the abiotic factors considered. (Mertz-PTT) PTT) W90-07153

MODELLING ECOLOGICAL IMPACTS OF THE ACIDIFICATION OF WELSH STREAMS: TEMPORAL CHANGES IN THE OCCUR-RENCE OF MACROFLORA AND MACROIN-VERTERRATES.

University Coll., Cardiff (Wales). Dept. of Applied Biology.

nary bibliographic entry see Field 7C.

PRODUCTION BY HEXAGENIA LIMBATA IN A WARM-WATER RESERVOIR AND ITS ASSOCIATION WITH CHLOROPHYLL CON-SOCIATION WITH CHLOROPHYLL CONTENT OF THE WATER COLUMN.
Baylor Univ., Waco, TX. Dept. of Biology.
C. L. Welch, and D. S. Vodopich.
Hydrobiologia HYDRB8, Vol. 185, No. 3, p 183193, November 1989. 6 fig, 2 tab, 39 ref.

Descriptors: *Aquatic fauna, *Chlorophyll, *Limnology, *Mayflies, *Reservoirs, *Texas, Dissolved oxygen, Hexagenia, Population density, Size-frequency method, Substrates, Temperature, Water sampling.

The productivity of nymphs of the mayfly Hexagenia limbata in Lake Waco, a central Texas reservoir was investigated, and its association with chlorophyll content of the water was assessed. It is hypothesized that food availability measured as chlorophyll content of the water may directly associate with growth of Hexagenia and predict population productivity. To test this, the production by mayfly populations at two stations in the same reservoir was compared; a northern station receiving water input with high chlorophyll content, and a southern station receiving water with low chlorophyll content. Both stations had similar substrate type and abundant mayfies. Benthic samples were collected from October 1984 through September 1985, and dissolved oxygen and temperature of the water were monitored. Annual production (Sizewater were monitored. Annual production (Size-frequency method) was 1270 mg/square m at the northern station and 1990 mg/square m at the

southern station. The mean standing crop was 323 mg/square m at the southern station and 169 mg/square m at the northern station. Densities of maylies at the two stations were not significantly different. Mean chlorophyll concentration (total different. Mean chlorophyll concentration (total mg pigment) during the sampling period was 23.5 mg/cubic m at the northern station and 16.7 mg/cubic m at the southern station. Therefore, the station with lower mean chlorophyll content had higher secondary productivity by Hexagenia. Conversely, the station with higher mean chlorophyll content had lower mayfly productivity. The productivity of the mayfly populations did not positively associate with the chlorophyll content of the water, and chlorophyll content did not predict the success of the population of Hexagenia. Variation in mayfly growth success was associated with differences in temperature and dissolved oxygen. The northern station with higher chlorophyll content and lower productivity had low dissolved oxygen and temperatures higher than optimum for growth. (Author's abstract)

WINTER AND SPRING MACROINVERTE-BRATE DRIFT IN AN OUTPOCKETING OF THE LOWER MISSISSIPPI RIVER, LOUISI-

THE LUWER PARSON
ANA (USA).
Louisiana State Univ., Baton Rouge. Dept. of Forestry and Wildlife Management.
P. Koetsier, and C. F. Bryan.
Hydrobiologia HYDRB8, Vol. 185, No. 3, p 205209, November 1989. 2 fig, 22 ref.

Descriptors: *Aquatic drift, *Aquatic habitats, *Macroinvertebrates, *Mississippi River, *Seasonal variation, *Temporal distribution, Benthic fauna, Benthos, Hydroida, Predation.

Invertebrates in stream benthic con Invertebrates in stream benthic communities utilize flow for downstream dispersal and to escape predation. This study was initiated to catalogue invertebrate drift during the fall, winter and early spring in a man-made outpocketing on the lower Mississippi River, as well as to characterize temporal and seasonal distributional drift patterns. To examine temporal variations in macroinvertebrate drift in a temporal variations in macroinvertebrate drift in a high-order river system, surface drift was sampled each month from November 1984 to June 1985. Routinely, two stations were sampled at 2-hour intervals through the night, but during January and April samples were taken every 4 hours for a 24-hour period. Greatest drift density occurred in April, when Hydroida dominated, while lowest densities occurred in December. Drifting organisms displayed the bigeminus pattern with highest densities 4 hours after dusk and lowest numbers one hour before sunrise. (Mertz-PTT) W90-07158

DAILY CHANGES OF UPTAKE OF INORGAN-IC CARBON AND NITROGEN, AND THEIR RELATION TO PHYTOPLANKTON BLOOMS IN LATE SPRING-EARLY SUMMER IN LAKE NAKANUMA, JAPAN. TSUKUBU Univ. (Japan). Inst. of Biological Sci-

ences. T. Miyazaki, M. Watase, and K. Miyake. Hydrobiologia HYDRB8, Vol. 185, No. 3, p 223-231, November 1989. 8 fig, 1 tab, 25 ref.

Descriptors: "Algae, "Ammonium, "Aquatic productivity, "Carbon, "Chlorophyll a, "Japan, "Limnology, "Nitrogen, "Nutrients, "Phytoplankton, Algae blooms, Growth rates, Lake Nakanuma.

Daily changes of inorganic carbon and nitrogen uptake were measured in May, 1986 in Lake Nakanuma, Japan. Uptake of inorganic carbon and ammonium in the light-bottle experiments in the Im layers, showed daily changes similar to chlorophyll a changes, though the uptake activities peaked before chlorophyll a peaks (phytoplankton blooms) appeared. Potential growth rates of phytoplankton and observed growth rates were calculated from the uptake rates and chlorophyll a changes. The potential growth rates did not always correspond to the observed growth rates. The potential growth rates did not always rates. The correlation between the observed growth rates and the loss rates was better. These

results suggest that though the increase of uptake activities may be necessary for occurrence of phy-toplankton blooms, loss processes may affect the occurrence of blooms. (Author's abstract)

PREDATION, SEDIMENT STABILITY AND FOOD AVAILABILITY AS DETERMINANTS OF THE BENTHIC INVERTEBRATE FAUNA IN TWO SHALLOW LAKES.

University of East Anglia, Norwich (England). School of Environmental Sciences. B. Moss, and M. Timms.

Hydrobiologia HYDRB8, Vol. 185, No. 3, p 249-257, November 1989. 2 fig, 3 tab, 37 ref.

Descriptors: *Benthic fauna, *England, *Butrophic lakes, *Lakes, *Limnology, *Predation, Chironomids, Macrophytes, Midges, Norfolk Broads, Oligochaetes, Organic matter, Population density, Suspended sediments, Waterlilies.

The Norfolk Broads, England are ancient man-made lakes excavated as peat pits between the ninth and fourteenth centuries and subsequently flooded by rising water tables. The sedimentary benthos of this series of shallow, eutrophicated lakes is, in general, low not only in number of species but unexpectedly in number of individuals. In two lakes, Hudsons Bay and Hoveton Great Broad, chironomids and oligochaetes dominated the fauna. Hudsons Bay has an extensive stand of water lilies (Nuphar lutea); Hoveton Great Broad does not. There were significant relationships be-tween number of chironomids and of Potamothrix hammoniensis with organic content of the sedihammoniensis with organic content of the sedi-ments, but these were due not to food availability ments, but these were due not to food availability but to the structure imparted to the otherwise fluid sediment by the organic matter. Sediment stabi-lized in plastic bowls developed much larger popu-lations of oligochaetes than found in the unrestrict-ed sediment. Protection of the community from ea seament. Protection of the community from fish predation resulted in a further major increase in numbers. Sediment stability and predation rather than food supply were the major determinants of these benthic populations. (Mertz-PTT) W90-07160

IN SITU PRIMARY PRODUCTION, BIOMASS AND LIGHT REGIME IN THE WOLDERWIJD, THE MOST STABLE OSCILLATORIA AGARD-HII LAKE IN THE NETHERLANDS.

Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands). C. Berger.

Hydrobiologia HYDRB8, Vol. 185, No. 3, p 233-244, November 1989. 6 fig, 7 tab, 37 ref.

Descriptors: *Algae, *Aquatic productivity, *Irradiation, *Lakes, *Limnology, *Primary productivity, *Temperature effects, *The Netherlands, Algal blooms, Biomass, Lake stratification, Oscillatoria, Phosphorus.

The Wolderwijd, in The Netherlands, man-made by closing the dykes of the Southern Flevoland polder in 1969 and covering an area of 2700 ha, has an average depth of 1.6 m and a residence time of around 0.9 year. The phosphorus load varies from 0.5 to 1.5 g P/square m/year. During the entire period of research from 1971 to 1982, Oscillatoria asarchii Groupat was overwhelmingly present in period of research from 191 to 1982, Oscillatoria agardhii Gomont was overwhelmingly present in the Wolderwijd. Six years of measurements of primary production has suggested that the gross production per day firstly is related to temperature and secondly to irradiation. However, the producand secondly to irradiation. However, the production per year is neither related to temperature nor to irradiation. In a cold summer, gross production is as high as in a warm summer due to higher production in the lower part of the euphotic zone. Up to an average depth of 2.5 m blooming of O. agardhii occurs easily, while light saturated production achieves its maximum between 2.0 and 2.5 m. Increasing depth leads to photo-inhibition in the upper layers followed by lowering of light saturated production. Only special circumstances such as days with microstratification allow growth; resulting in a monoculture of the alga. (Mertz-PTT) ing in a monoculture of the alga. (Mertz-PTT)

Lakes-Group 2H

ARAL SEA AND THE ECOLOGICAL SITUA-TION IN CENTRAL ASIA AND KAZAKHSTAN, For primary bibliographic entry see Field 6G.

NEW METHOD OF QUANTITATIVELY DE-SCRIBING DRAINAGE AREAS.
Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 7C.
W90-07190

LONG-TERM CHANGE IN THE SUITABILITY JOS JERM CHANGE IN THE SUITABILITY OF WELSH STREAMS FOR DIPPERS CITY CLUS CINCLUS AS A RESULT OF ACIDIFICA-TION AND RECOVERY: A MODELLING STUDY.

STUDY. University Coll., Cardiff (Wales). School of Pure and Applied Biology. For primary bibliographic entry see Field 5C. W90-07194

ACID AND ALUMINUM EFFECTS ON FRESH-WATER ZOOPLANKTON: AN IN SITU MESO-COSM STUDY.

Kent State Univ., OH. Dept. of Biological Sciences.

For primary bibliographic entry see Field 5C. W90-07196

ASSESSMENT OF NUTRIENT EFFECTS AND NUTRIENT LIMITATION IN LAKE OKEE-CHOREE.

Florida Univ., Gainesville. Dept. of Fisheries and Aquaculture. For primary bibliographic entry see Field 5C. W90-07202

OXYGEN DEMAND IN ICE COVERED LAKES AS IT PERTAINS TO WINTER AERATION. Minnesota Univ., Minneapolis. St. Anthony Falls

Hydraunc Lab. C. R. Ellis, and H. G. Stefan. Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1169-1176, December 1989. 5 fig, 1 tab, 45 ref.

Descriptors: *Aeration, *Fishkill, *Ice cover, *Lake ice, *Limnology, *Oxygen demand, Fish, Lake management, Lake sediments, Oxygen transport, Seasonal variation, Water quality, Winterkill.

Winterkill, the death of fish under ice due to oxygen deficiency, threatens hundreds of shallow lakes in the upper Midwest of the U.S. every winter. For decades, attempts have been made to prevent winterkill, usually through aeration, with mixed results. In large part, the failure of strategies to prevent winterkill can be linked to a lack of understanding of winter limnology and in particular, of oxygen dynamics under ice. Most winterkill lakes behave as closed systems with regard to oxygen. Consequently, the content of an ice and snow covered lake is essentially a function of the amount of initial storage and the rate of depletion. amount of initial storage and the rate of depletion. Should the stored oxygen be insufficient to prevent near anoxia before melting of the ice cover occurs, winterkill will result. Most oxygen consumption in ice covered lakes is due to bacterial respiration and chemical oxidation at the sediment/water inter-face, the remainder occurring in the water column. Oxygen consumption (and thus depletion) is a function of the velocity and oxygen concentration of the near sediment water. This is due to the fact of the near sediment water. I his is due to the fact that oxygen transport to the sediment is mediated by a diffusive boundary layer adjacent to the sedi-ment surface. Winter oxygen depletion rates de-crease when the oxygen concentration of the over-lying water falls below about 3 mg/L. Aeration techniques which increase the oxygen concentration and velocity of the near-sediment water also increase the oxygen consumption (depletion) rate. (Author's abstract) W90-07206

PROPOSED MODIFICATION TO REGULA-TION OF LAKE OKEECHOBEE. South Florida Water Management District, West Palm Beach. Water Resources Div.

For primary bibliographic entry see Field 4A. W90-07214

IMPROVED GROWTH IN STUNTED BROWN TROUT (SALMO TRUTTA L.) AFTER RELIM-ING OF LAKE HOVVATN, SOUTHERN

NORWAY.

Bergen Univ. (Norway). Zoological Museum.

For primary bibliographic entry see Field 5G.

W90-07223

MERCURY LEVELS IN THE SEDIMENT, WATER, AND SELECTED FINFISHES OF LAGUNA LAKE, THE PHILIPPINES. Southeast Asian Fisheries Development Center, Iloilo (Philippines). Aquaculture Dept. For primary bibliographic entry see Field 5B. W90-07226

MODELLING WATER TEMPERATURE BENEATH RIVER ICE COVERS.

NEATH RIVER ICE COVERS.
National Hydrology Research Inst., Saskatoon (Saskatchewan).
P. Marsh.
Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 1, p 36-44, February 1990. 7 fig, 36

Descriptors: *Ice cover, *Model studies, *Rivers, *Water temperature, Ice breakup, Liard River, Water depth.

The water temperature beneath river ice covers has an important influence on the heat flux to the overlying ice cover and on ice melt. Measurements of water temperature beneath the Liard River ice cover showed that prior to spring breakup, the water temperature was always between 0.0 and 0.025 degrees C, with important cross-channel and diurnal variations. The lowest temperatures were controlled by the bed heat flux and frictional heating, while variations above these minimum values were explained by changes in solar radiation. were explained by changes in solar radiation. Using measurements of these heat fluxes, in conjunction with measurements of ice and bed rough-ness, water depth and velocity, and slope, a simple method which assumes the similarity between heat and momentum transfer, was able to accurately and momentum transfer, was able to accurately predict water temperatures beneath the ice cover. During breakup when the river had both ice-free and ice-covered sections, water temperatures rose to a few degrees above 0 C. When this water entered an ice-covered reach, the water temperature declined rapidly to near 0 C within 10 km. This temperature decay was predicted from measurements of the initial temperature, ice and bed roughness, and water depth. Using a similar approach, it was estimated that only 1-3 km was required for a new equilibrium temperature to be approached beneath the prebreakup ice cover. (Author's abstract) W90-07235

IMPACT OF A MASSIVE CRUDE OIL SPILL ON THE INVERTEBRATE FAUNA OF A MIS-SOURI OZARK STREAM. Missouri Dept. of Conservation, Columbia. For primary bibliographic entry see Field 5C. W90-07239

ACCURACY AND INTERPRETATION OF GROWTH CURVES OF PLANKTONIC ALGAE. Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W90-07264

STUDY OF PHOSPHATE LIMITATION IN LAKE MAARSSEVEEN: PHOSPHATE UPTAKE KINETICS VERSUS BIOASSAYS. Water Board of Utrecht (Netherlands). For primary bibliographic entry see Field 5A. W90-07267

EVIDENCE FROM ALGAL BIOASSAYS OF SEASONAL NUTRIENT LIMITATIONS IN TWO ENGLISH LAKES.

Freshwater Biological Association, Ambleside (England). For primary bibliographic entry see Field 5A. W90.07268

EXAMINATION OF THE EFFECT OF WASTEWATER ON THE PRODUCTIVITY OF LAKE ZURICH WATER USING INDIGENOUS PHYTOPLANKTON BATCH

Zurich Univ., Kilchberg (Swizerland). Hydrobio-logical-Limnological Station. For primary bibliographic entry see Field 5C. W90-07269

FINE STRUCTURE OF AN ALGAL MAT FROM A FRESHWATER MARITIME ANT-ARCTIC LAKE,

Portsmouth Polytechnic (England). School of Biological Sciences D. R. Oppenheim, and D. M. Paterson.

Canadian Journal of Botany CJBOAW, Vol. 68, No. 1, p 174-183, January 1990. 26 fig, 38 ref.

Descriptors: *Algae, *Antarctica, *Diatoms, *Epi-phytes, *Lakes, Algal mats, Community structure, Growth strategies, Plant populations, Species di-

The three-dimensional microstructure of Tolypothrix mats from the bottom of a maritime anarcpothrix mats from the bottom of a maritime anarc-tic lake of Signy Island, South Orkneys, was exam-ined. Samples from mats at two depths, 4 and 6m, within the lake were taken by scuba divers and frozen (-80 C) in March 1987. The samples were freeze-fractured and examined by ambient and low temperature scanning electron microscopy (LTSEM). The mats shared a similar structure consisting of a compact lower zone of prostrate consisting of a compact lower zone of prostrate filaments and an upper zone of loose vertical filanuments and an upper zone of loose vertical fila-ments. An outer layer of extremely loose spreading filaments was only found by LTSEM, leading to the conclusion that some collapse of the mat struc-ture occurred during dehydration for ambient scanning electron microscopy (SEM). A variety of attachment stategies were observed although ses-sile forms were most common. Further fast-particle etching of the epiphytic diatom assemblages revealed that many of the attached diatoms were devoid of cell contents. Together with the epiphy-tic diatoms a variety of microfauna were identified, both incorporated within the mat and on the mat surface. It is likely that the loose upper layer of upright filaments represents recent growth that becomes compacted by the overgrowth of younger filaments and sediment accretion. Light may also play a significant role in determining mat structure. The loose basal layer found in some samples is The loose basal layer found in some samples is believed to be an artifact caused by disruption of the mats during their removal from the sediment. The abundant microfauna present in the algal mats will affect competition for space, whereas grazing is a major influence on the colonization and survival of benthic diatoms. It is suspected that structural damage to the lower margin of the mat was caused during sampling. Sampling could be improved by the use of an in situ freezing method. (White-Reimer-PTT) W90-07314

CHANGES IN PLANKTON COMMUNITIES IN REGULATED REACHES OF THE LOWER RHINE RIVER.

Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). For primary bibliographic entry see Field 6G. W90-07336

TIME SCALES FOR THE RECOVERY POTEN-TIAL OF RIVER COMMUNITIES AFTER RES-TORATION: LESSONS TO BE LEARNED FROM SMALLER STREAMS.

Karlsruhe Univ. (Germany, F.R.). Zoologisches Inst. U. Fuchs, and B. Statzner.

Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 1, p 77-87, January/February 1990. 3 fig, 5 tab, 32 ref.

Field 2-WATER CYCLE

Group 2H-Lakes

otors: *Benthic fauna, *Rehabilitation, ns, *West Germany, Aquatic habitats, Colo-Descriptors:

It is anticipated that small streams should show recovery sooner after restoration or reduction in detrimental human influence than larger streams. With this expectation in mind, two restoration projects in German lowland streams, differing in their degree of isolation, were studied to determine the time periods that could be expected for the recovery of Central European rivers. The two study sites were Lower Schierenseebach in Northstudy sites were Lower Scinerenseemen in North-ern Germany, near Kiel, and the Giessbach in the Upper Rhine valley on the outskirts of Karlsruhe. Quantitative benthic samples were obtained by using box samplers, modified Surber samplers, and Eckmann grabs. Under optimal conditions, as oc-curred at Lower Schierenseebach where almost completely intact communities upstream and downstream from the 400-m restored (study) downstream from the 40-m restored (study) reach, sufficient recovery of the macroinvertebrate fauna could be achieved in relatively short periods. However, in the relatively isolated area of Giessbach, where the closest intact lotic ecosystems of a comparable type were 20-25 km away, a sufficient recovery of benthic macroinvertebrates was not achieved within 5 yr after restoration, despite the existence of high diversity of physical habitats and cascince of ingli investing physical anotats and the acceptable water quality (except for two oil accidents in the fourth and fifth year). It is concluded that recovery of a large Central European river ecosystem like the Rhine, which has lost a large number of its former species and is more isolated than small streams, will require more than 12 yr to reach a state significantly different from the present one. (Rochester-PTT) W90-07337

ENGINEERING OPERATIONS AND INVERTEBRATES: LINKING HYDROLOGY WITH ECOLOGY.

Leicester Univ. (England).

For primary bibliographic entry see Field 6G. W90-07338

VOLATILE COMPOUNDS ASSOCIATED WITH AQUATIC HUMIC SUBSTANCES.

National Inst. of Public Health, Oslo (Norway). G. Becher, M. Froshaug, and E. T. Gjess Science of the Total Environment STENDL, Vol. 81/82, p 279-285, June 1989. 2 fig, 2 tab, 13 ref.

Descriptors: *Humic substances, *Separation techniques, *Volatile organic compounds, Adsorption, Aromatic compounds, Lake sediments, Norway,

Humic water and solid humic matter, isolated from a small marsh area of Norway by evaporation at reduced pressure and the International Humic Substances Society XAD-resin procedure, have been purged with highly purified nitrogen. The volatiles were adsorbed onto activated charcoal and the extracts analyzed by capillary gas chromatography. While little material is purged from water, considerable amounts of volatiles were stripped from the solid concentrates. The amount and profrom the sond concentrates. The amount and pro-file of the volatile compounds were dependent on the isolation technique. Dominating components were cyclic siloxanes and n-alkanes and alkenes with even carbon numbers. These compounds have been previously identified in sediments of various water environments and it is suggested that they are mobilized into the water by humic substances. It appears that some of the volatile components are regenerated after exhaustive purging and subsequent storage at 4 C. (Author's abstract) W90-07379

FACTORS AFFECTING THE VARIATION IN THE AVERAGE MOLECULAR WEIGHT OF DISSOLVED ORGANIC CARBON IN FRESH-

Toronto Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field 2K. RATIONAL APPROACH TO THE ASSESSMENT OF ALUMINIUM SOLUBILITY CON-

MENT OF ALUMINIUM SOLUBILITY (TROLS IN FRESHWATERS. Senter for Industriforskning, Oslo (Norway). For primary bibliographic entry see Field 5B. W90-07391

THYMIDINE INCORPORATION IN SALTERN PONDS OF DIFFERENT SALINITIES: ESTI-MATION OF IN SITU GROWTH RATES OF HALOPHILIC ARCHAEOBACTERIA AND EU-BACTERIA.

Hebrew Univ. of Jerusalem (Israel). Div. of Micro-bial and Molecular Ecology.

Data and A. Oren.
A. Oren.
Microbial Ecology MCBEBU, Vol. 19, No. 1, p
43-51, January/February 1990. 3 fig, 19 ref.

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Saline water, *Thymidine, Aphidicolin, Ar-chaeobacteria, Deoxyribonucleic acid, Eubacteria, Growth rates, Halophilic bacteria, Nalidixic acid.

Incorporation of methyl(3H)thymidine was measured in solar saltern ponds of different salinities. Estimated doubling times of the bacterial communities were in the range of 1.1 to 2.2.6 days. Even at the highest salt concentrations (NaCl saturation), relatively rapid thymidine incorporation was observed. In an attempt to differentiate between activity of halpshiftic archaeological (the Halpshift). served. In an attempt to differentiate between ac-tivity of halophilic archaeobacteria (the Halobac-terium group) and halophilic eubacteria, taurocho-late, which causes lysis of the halobacteria without affecting eubacteria, was used. At salt concentra-tions exceeding 250 g/iter all thymidine incorpo-ration activity could be attributed to halobacteria. ration activity could be attributed to naiobacteria. Aphidicolin, a potent inhibitor of DNA synthesis in halobacteria, completely abolished thymidine incorporation at the highest salinities, but also caused significant inhibition at salinities at which halobacteria are expected to be absent. Attempts to national materials and the expected to be absent. Attempts to use nalidixic acid to selectively inhibit DNA synthesis by the eubacterial communities were unsuccessful. (Author's abstract) W90-07409

BACTERIAL PRODUCTION IN FRESHWATER SEDIMENTS: CELL SYSTEM MEASURES. SPECIFIC

SYSTEM MEASURES.
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Central Research and Development Dept. R. D. Fallon, and C. W. Boylen.
Microbial Ecology MCBEBU, Vol. 19, No. 1, p 53-62, January/February 1990. 1 fig, 4 tab, 35 ref.

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Respiration, *Thymidine, Growth rates, Methyl(3H)thymidine, Productivity, Sediments,

Estimates of bacterial production based on total trichloroacetic acid (TCA)-precipitable methyl(3H)thymidine incorporation and frequency of dividing cell (FDC) techniques were compared of dividing cell (FDC) tecninques were compared to sediment respiration rates in Lake George, New York. Bacterial growth rates based on thymidine incorporation ranged from 0.024 to 0.41/day, while rates based on FDC ranged from 1.78 to 2.48/day. Respiration rates ranged from 0.11 to 1.8 2.48/day. Respiration rates ranged from 0.11 to 1.8 micromol oxygen/hr/g dry weight sediment. Thymidine incorporation yielded production estimates which were in reasonable agreement with respiration rates. Production estimates based on FDC were 4-fold to 190-fold higher than those predicted from respiration rates. (Author's abstract) W90-07410

DENITRIFICATION AND OXYGEN RESPIRA-TION IN BIOFILMS STUDIED WITH A MI-CROSENSOR FOR NITROUS OXIDE AND

Aarhus Univ. (Denmark). Inst. of Ecology and L. P. Nielsen, P. B. Christensen, N. P. Revsbech,

and J. Sorensen.

Microbial Ecology MCBEBU, Vol. 19, No. 1, p 63-72, January/February 1990. 4 fig, 27 ref.

Descriptors: *Biofilms, *Denitrification, *Dissolved oxygen, *Nitrous oxide, *Respiration, *Sen-

sors, Anoxic conditions, Depth, Dissolved oxygen profiles, Model studies, Organic matter, Polarographic microsensors.

Depth distributions of oxygen respiration and denitrification activity were studied in 1-mm to 2-mm thick biofilms from nutrient-rich Danish streams. Acetylene was added to block the reduction of nitrous oxide and microprofiles of oxygen and nitrous oxide in the biofilm were measured simultaneously with a polarographic microsensor. The specific activities of the two respiratory processes were calculated from the microprofiles using a one-dimensional diffusion-reaction model. Denitrioffication only occurred in layers where oxygen was absent or present at low concentrations (of a few micromol). Introduction of oxygen into deeper layers inhibited denitrification, but the process micromol). Introduction of oxygen into deeper layers inhibited denitrification, but the process started immediately after anoxic conditions were reestablished. Denitrification activity was present at greater depth in the biofilm when the nitrate concentration in the overlying water was elevated, and the deepest occurrence of denitrification was apparently determined by the depth penetration of nitrate. The denitrification rate within each specification was the order of the process in price to the price to the process in price to the price ic layer was not affected by an increase in nitrate concentration, and the half-saturation concentraconcentration, and the nair-saturation concentra-tion for nitrate was therefore considered to be low (<25 micromol). Addition of 0.2% yeast extract stimulated denitrification only in the uppermost 0.2 mm of the denitrification zone indicating a very efficient utilization of the dissolved organic matter within the layers of the biofilm. (Author's abstract)

MICROBIAL COMMUNITY STRUCTURE AND BIOMASS ESTIMATES OF A METHANO-GENIC ANTARCTIC LAKE ECOSYSTEM AS DETERMINED BY PHOSPHOLIPID ANALY-

Tasmania Univ., Hobart (Australia). Dept. of Agricultural Science.

C. A. Mancuso, P. D. Franzmann, H. R. Burton, and P. D. Nichols.

Microbial Ecology MCBEBU, Vol. 19, No. 1, p 73-95, January/February 1990. 5 fig, 4 tab, 59 ref.

Descriptors: *Antarctica, *Chemical analysis, *Limnology, *Meromictic lakes, *Methanogenesis, *Microbial degradation, Ace Lake, Depth, Methanogenic biomass, Microeukaryotes, Sediments, Sulfate-reducing bacteria.

Phospholipid analyses were performed on water column particulate and sediment samples from Ace Lake, a meromictic lake in the Vestfold Hills, Antarctica, to estimate the viable microbial biomass and community structure in the lake. In the water column, methanogenic bacterial phospholi-pids were present below 17 m in depth at concen-trations which converted to a biomass of between pids were present below I/n in depth at concentrations which converted to a biomass of between 1 and 700 million cells/liter. Methanogenic biomass in the sediment ranged from I/n. Pillion cells/g dry weight of sediment at the surface to 100 million cells/g dry weight at 2 m in depth. This relatively high methanogenic biomass implies that current microbial degradation of organic carbon in Ace Lake sediments may occur at extremely slow rates. Total microbial biomass increased from 440 million cells/liter at 23 m, near the bottom of the water column. Total nonarchaebacterial biomass decreased from 4.2 billion cells/g dry weight in the surface sediment (I/4 the biomass of methanogens) to 6 million cells/g veight at 2 m in depth in the sediment. Phospholipid fatty acid profiles showed that microeukaryotes were the major microbial group present in the oxylimnion of the lake while bacteria dominated the lower anoxic zone. Sulfate-reducing bacteria (SRB) comprised 25% of write bacteria dominated the lower anoxic zone. Sulfate-reducing bacteria (SRB) comprised 25% of the microbial population at 23 m in depth in the water column particulates and were present in the surface sediment but to a lesser extent. This is the first known instance in which the viable biomass of methanogenic and SRB have been estimated for an antarctic microbial community. (Author's abstract)

NITROGEN ANALYSES IN EUTROPHIC AL-KALINE AND PEATY WATERS: A COMPARI-

Water In Plants-Group 21

SON OF DIFFERENT METHODS TO ANA-LYSE AMMONIA-NITROGEN. Limnologisch Inst., Oosterzee (Netherlands). Tjeu-kemeer Lab.

For primary bibliographic entry see Field 7B. W90-07424

CYANOBACTERIA (BLUE-GREEN ALGAE) IN WISCONSIN WATERS: ACUTE AND CHRON-

IC TOXICITY.
Wisconsin Univ-Madison. Lab. of Hygiene.
W. M. Repavich, W. C. Sonzogni, J. H.
Standridge, R. E. Wedepohl, and L. F. Meisner.
Water Research WATRAG, Vol. 24, No. 2, p 225231, February 1990. 2 fig, 5 tab, 22 ref.

Descriptors: *Algal blooms, *Algal toxins, *Cyanophyta, *Eutrophic lakes, *Livestock, *Toxicity, *Water pollution effects, Chromosome breakage, Sporulation test, Wisconsin.

Toxins produced by several species of cyanobacteria (blue-green algae) are a potentially serious environmental problem. These substances can be acutely toxic as evidenced by the death of live-stock and other animals that have been exposed to stock and other animals that have been exposed to them. In this study, samples collected from 102 sites in Wisconsin were analyzed for toxicity. Acute toxicity was tested by intraperitoneally in-jecting mice with lysed algal cells (identified to genus) and observing the effects. Chronic toxicity was tested using the Salmonella typhimurium mu-tagenicity test, the Bacillus subtilis multigene sportagenicity test, the Bacillus subtilis multigene spor-ulation test and a chromosome breakage test using human lymphocytes. Mouse bioassay results showed that about 25% of the sites contained toxic algae, indicating acutely toxic algae are common-place in Wisconsin waters. Bacterial assay results suggested the toxins were not directly mutagenic, but a chromosomal breakage test suggested the possibility that the algal toxins may be clastogenic. Overall, the results indicate that algal toxins may be more serious environmental hazards than gener-ally recognized. (Author's abstract) W90-07425

DEVELOPMENT OF CRITICAL LIFE STAGE ASSAYS: TERATOGENIC EFFECTS OF ASH BASIN EFFLUENT COMPONENTS ON FRESHWATER FISH, GAMBUSIA AFFINIS AND DAPHNIA. Voorhees Coll., Denmark, SC. For primary bibliographic entry see Field 5C. W90.07465.

STEEL CREEK WATER QUALITY: L LAKE/ STEEL CREEK BIOLOGICAL MONITORING PROGRAM, NOVEMBER 1985-DECEMBER

Environmental and Chemical Sciences, Inc., Aiken, SC. For primary bibliographic entry see Field 5B. W90-07470

KANSAS CLEAN LAKES PROGRAM, LAKE OLATHE, CITY OF OLATHE, KANSAS. Kansas Dept. of Health and Environment, Topeka. For primary bibliographic entry see Field 4C W90-07492

CAPITAL LAKE FINAL REPORT.
South Dakota Dept. of Water and Natural Re-

For primary bibliographic entry see Field 4D. W90-07493

SURVEY AND CLASSIFICATION OF DELA-WARE'S PUBLIC LAKES. Delaware State Dept. of Natural Resources and Environmental Control, Dover.

W. F. Ritter.

Available from the National Technical Information Available from the National Technical minimation Service, Springfield, VA. 22161, as PB89-209944. Price codes: A18 in paper copy, A01 in microfiche. Report prepared for U.S. Environmental Protec-tion Agency, Philadelphia, PA, March 1981. 459p, 31 fig, 8 tab, 23 ref, append. EPA Grant S003150-

61-1

Descriptors: *Delaware, *Lake classification, *Lake restoration, *Lakes, *Limnology, *Water quality, Aquatic vegetation, Chlorophyll a, Classi-fication, Coliforms, Dissolved oxygen, Eutrophic lakes, Eutrophication, Hydrogen ion concentra-tion, Nitrogen, Phosphorus, Recreation.

Thirty public lakes in Delaware were sampled for a year and classified according to trophic condi-tions. Samples were analyzed for orthophosphortions. Samples were analyzed for orthophosphorous, total phosphorus, organic nitrogen, ammonia, nitrate-nitrite nitrogen, pH, acidity, alkalinity, hardness, chlorophyll a, total coliform, fecal coliform and dissolved oxygen. Temperature and secchi disc readings were also taken. Annual nitrogen and phosphorus budgets were estimated for each lake. A priority classification for lake restoration was developed for the 30 lakes. The factors involved in the priority ratings were: (1) aquatic vegetation problems in the lake; (2) recreational potential of the lake; (3) interest displayed by the surrounding population in the condition of the lake and the potential of available money for the restoration of the lake; and (4) eutrophication status of the lake. A five parameter eutrophication index ration of the lake; and (4) eutrophication status of the lake. A five parameter eutrophication index involving total phosphorus, total nitrogen, chloro-phyll a, secchi disc and dissolved oxygen deficit was also developed for the lakes. Most of the lakes was also developed for the lakes. Most of the lakes were phosphorus limited and highly eutrophic. The five parameter eutrophication index did not describe the trophic status of all 30 lakes. The Vollenweider model and the three Carlson trophic indexes were not satisfactory for describing eutro-phic conditions in Delaware lakes. Lake Como received the top priority rating for lake restoration followed by the Milford Chain of Lakes and Lums Pond. (Author's abstract) W90-07495

2I. Water In Plants

BIOGEOCHEMICAL CYCLES IN FORESTS OF THE SIERRA DE BEJAR (SALAMANCA, SPAIN): RETURN OF BIOELEMENTS IN RAINFALL.

Instituto de Microbiologia Bioquimica, Salamanca (Spain).

For primary bibliographic entry see Field 2K. W90-06861

RAINFALL INTERCEPTION BY BRACKEN LITTER: RELATIONSHIP BETWEEN BIO-MASS, STORAGE, AND DRAINAGE RATE. King's Coll., London (England). Dept. of Geogra-

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 281-291, November 1989. 3 fig, 1 tab, 33 ref.

Descriptors: *Ferns, *Interception, *Litter, *Rainfall, Artificial precipitation, Biomass, Bracken, Evaporation, Mathematical analysis, Simulation, Water loss.

A rainfall simulator was used to investigate the relationship between canopy storage (C) and drainage rate (Ds) of bracken (Pteridium aquilinum) age rate (DS) of oracken (retrollum adulinum) litter. Measured maximum storage, Cmax, for the litter was 4.84 mm/kg per sq m and litter storage capacity, Cmin, was 1.67 mm/kg per sq m. Ds was found to be related to C by an exponential function: Ds = e to K(C-Cmin) power-1. Optimization of the function for K accounted for 96% of the variation between Ds and C. Comparison of the values K and Cmin with those reported previously showed that K was a simple function of Cmin for showed that K was a simple function of Cmin for both bracken litter and bracken fronds (R square = 0.991). Because K is predictable from values of Cmin determined from the leaf area index or biomass (kg/sq m) the equation for Ds has wide applicability to both bracken litter and bracken frond drainage rates. Litter storage capacity also is important because at rainfalls of < 0.5 mm are wholly intercepted by the upper layers of the fronds during the growing season. (Author's abstract) stract) W90-06899

STUDY OF SOIL WATER CHANGES IN A PEANUT FIELD (IN CHINESE). National Taiwan Univ., Taipei. Dept. of Agricul-

For primary bibliographic entry see Field 2G. W90-06905

GENETIC VARIANCES FOR FORAGE YIELD IN CRESTED WHEATGRASS AT SIX LEVELS

OF IRRIGATION.
Agricultural Research Service, Logan, UT. Forage and Range Research Lab.
For primary bibliographic entry see Field 3F. W90-07404

LEAF WATER CONTENT AND GAS-EX-CHANGE PARAMETERS OF TWO WHEAT GENOTYPES DIFFERING IN DROUGHT RE-

Purdue Univ., Lafavette, IN. Dent. of Botany and

Plant Pathology.
S. W. Ritchie, H. T. Nguyen, and A. S. Holaday.
Crop Science CRPSAY, Vol. 30, No. 1, p 105-111,
January/February 1990. 7 fig. 16 ref.

Descriptors: *Drought resistance, *Genetics, *Grain crops, *Wheat, Leaf water content, Photosynthesis, Stress.

It is still unclear what parameter(s), other than grain yield, might be a suitable indicator in a wheat (Triticum aestivum) breeding program for drought resistance. In this study, the leaf relative water content (RWC) and gas-exchange parameters were compared between a drought-resistant winter wheat genotype (cultivar TAM W-101) and a drought-susceptible genotype (cultivar Sturdy) to determine if these physiological parameters contribute to drought resistance in TAM W-101. Plants were grown under well-watered conditions tribute to drought resistance in TAM W-101. Plants were grown under well-watered conditions in growth chambers until drought stress was imposed by limited watering of plants at anthesis or during vegetative growth. In both growth stages, TAM W-101 maintained a higher RWC and apparent photosynthesis (A) than Sturdy under moderate to severe drought stress. TAM W-101 plants also maintained a higher photosynthetic capacity (higher A at a given intercellular carbon dioxide concentration) under stress than did Sturdy in both growth stages. Photosynthetic water use efficiency (pWUE = A/stomatal conductance) generally increased with stress severity until very severe stress levels were attained. Thus, genotypic pWUE comcreased with stress severity until very severe stress levels were attained. Thus, genotypic pWUE comparisons using stressed plants should be evaluated on a water-status basis (e.g. RWC) to avoid the confounding effect of stress severity on pWUE. TAM W-101 tended to have higher pWUE (RWC basis) than Sturdy under moderate to severe stress but not under well-watered conditions. oasis) than study their moderate is severe stress, conditions, but not under well-watered conditions. High leaf RWC, A, and photosynthetic capacity are traits that may contribute to drought resistance in TAM W-101. (Author's abstract) W90-07405

FIELD DROUGHT TOLERANCE OF A SOY-BEAN PLANT INTRODUCTION.

North Carolina State Univ. at Raleigh. Dept. of Crop Science.

R. J. Sloane, R. P. Patterson, and T. E. Carter. Crop Science CRPSAY, Vol. 30, No. 1, p 118-123, January/February 1990. 4 fig, 2 tab, 29 ref.

Descriptors: *Crops, *Drought resistance, *Genetics, *Soybeans, Comparison studies, Genotypes, Leaf water, Soil types, Solute accumulation.

Rainfall is seldom sufficient to meet the evapora-tive and transpirational demands of a soybean crop (Glycine max) in the southeastern USA. Develop-ment of new drought-tolerant cultivars would thus seem an effective way in which to address the problem of moisture stress. Unfortunately, few drought-tolerance genotypes have been identified for use as breeding stock. The objective of this study was to compare the relative drought tolerstudy was to compare the relative trought obtained ance of plant introduction PI 416937, a visually slow-wilting accession, with that of 'Forrest', a popular cultivar of similar maturity. Leaf water potential, leaf water potential solute potential SP,

Field 2—WATER CYCLE

Group 21-Water In Plants

and relative water content (RWC) of these geno-types were measured under two levels of soil water adjustment (well-watered and water-stress at water adjustment (well-watered and water-stress at early pod-fill) during 2 yr in the field (on a Varina loamy sand, a clayey, kaolinitic, thermic Plinthic Paleudult). Although water stress reduced leaf water potential equally for both genotypes, PI 416937 maintained lower levels of SP and higher levels of pressure potential and RWC than Forrest.

A comparison of the relationship between RWC and SP for the two genotypes indicated that the PI may accumulate more solutes in leaf tissue under stress than Forrest. That is, at a normalized leaf pressure potential of zero, the SP of the PI was estimated to be 0.3 MPa lower than that of Forrest. Seed yields of Forrest and the unadapted PI were comparable under stress. However, stress reduced the yield of Forrest by more than half while reduc-ing yield of the PI by only a third. The superior turgor maintenance and competitive yielding abili-ty of the unadapted PI under stress indicated that the PI may be an important source of drought tolerance for breeding programs. (Author's ab-W90-07406

PHOSPHORUS ENHANCEMENT OF SALT TOLERANCE OF TOMATO. New South Wales Dept. of Agriculture, Rydal-mere (Australia). Biological and Chemical Research Inst.

For primary bibliographic entry see Field 3C. W90-07407

WATER-USE EFFICIENCY AND YIELD OF

WAIER-USE EFFICIENCY AND YIELD OF SAINFOIN AND ALFALFA. Texas Tech Univ., Lubbock. Dept. of Agronomy, Horticulture, and Entomology. T. P. Bolger, and A. G. Matches. Crop Science CRPSAY, Vol. 30, No. 1, p 143-148, January/February 1990. 6 fig, 3 tab, 24 ref.

Descriptors: *Alfalfa, *Arid lands, *Forages, *Irrigation requirements, *Sainfoin, *Semiarid lands, Dormancy, Evaporation, Leaf area index, Seasonal variation, Water use efficiency, Yield.

Water is often the primary limiting resource for forage production in semiarid and arid regions. The objective of the study was to determine yield and water-use efficiency (WUE) of sainfoin (Onobrychis viciifolia) and alfalfa (Medicago sativa) as related to evapotranspiration (ET). Species were grown in rows under an irrigation gradient. Total seasonal yields were a linear function of ET for seasonal yields were a linear function of ET for both species. Maximum sainfoin yields were 85% of alfalfa (20.7 Mg/ha). Sainfoin produced 58 to 63% of its total yield in the first two harvests as compared to 41 to 46% for alfalfa. When soil water was adequate for spring growth, sainfoin was ready to harvest 2 wk earlier than alfalfa. Total ET of both species was similar. Season-long WUE of alfalfa (18.3 kg/ha/mm) was greater than sainfoin (10.7 kg/ha/mm) in 1986 due to a lack of water in spring when sainfoin yield potential and sainfoin (10.7 kg/ha/mm) in 1986 due to a lack of water in spring when sainfoin yield potential and WUE is highest. In 1987, seasonal WUE of sainfoin and affalfa was similar (18.2 vs 16.7 kg/ha/mm), but alfalfa had a smaller evaporation (E) component giving it greater overall WUE and yield. Sainfoin WUE remained high throughout the spring and summer. Both species had low WUE in the fall due to dormancy responses. Differences in leaf area index account for differences in E between sainfoin and alfalfa Sudden death of in E between sainfoin and alfalfa. Sudden death of sainfoin plants in summer was observed under low irrigation; therefore, moderate levels of summer irrigation may be necessary to prevent stand loss. In dryland areas, sainfoin's greatest utility is for early season irrigated pasture or hay. (Author's W90-07408

2J. Erosion and Sedimentation

MEASUREMENT OF BACTERIAL SULFATE REDUCTION IN SEDIMENTS: EVALUATION OF A SINGLE-STEP CHROMIUM REDUCTION METHOD.

Aarhus Univ. (Denmark). Inst. of Ecology and

Genetics. For primary bibliographic entry see Field 2K. W90-06555

SEMIQUANTITATIVE X-RAY DIFFRACTION METHOD TO DETERMINE MINERAL COM-POSITION IN STREAM SEDIMENTS WITH SIMILAR MINERALOGY.

Geological Survey, Reston, VA For primary bibliographic entry see Field 7B. W90-06625

CONVERSION OF THE DIGITAL LAND IN-FORMATION FILES FOR THE PURPOSE OF DRAWING RIVER BED PROFILES.

Tokyo Univ. (Japan). For primary bibliographic entry see Field 7C. W90-06661

PLUTONIUM, LEAD-210, AND CARBON ISO-TOPES IN THE SAVANNAH ESTUARY: RI-VERBORNE VERSUS MARINE SOURCES. Oak Ridge National Lab., TN. Environmental Sci-

C. R. Olsen, M. Thein, I. L. Larsen, P. D. Lowry, and P. J. Mulholland.

Environmental Science and Technology ESTHAG, Vol 23, No. 12, p 1475-1481, December 1989. 3 fig, 3 tab, 38 ref.

Descriptors: *Estuaries, *Isotopic tracers, *Pluto-nium, *Savannah River Plant, *Sediment transport, *Tracers, *Water pollution sources, Carbon, Coastal waters, Dissolved solids, Lead, Marine sediments, Ocean dumping, Rivers, Sea level, Suspended solids

Plutonium-238 from the Savannah River Plant labels riverborne particles, providing a unique opportunity for tracing river-ocean exchange processes. Results indicate that plutonium and lead-210 are enriched on estuarine particles and that inputs of plutonium from oceanic sources greatly exceed inputs from riverborne or drainage-basin sources as far upstream as 30 kilometers in the Savannah River estuary. This is near the landward limit of seawater penetration. Sediment resuspension in dy-namic coastal areas, sorption onto fine particles, and landward transport mechanisms for removing dissolved plutonium and lead-210 from oceanic water and for concentrating these two radionucleides in estuarine areas. Since estuaries, bays, and intertidal areas serve as effective traps for fine particles and associated substances, this landward transport from the ocean has important implications concerning the disposal of chemically reac-tive substances in oceanic waters off coastlines affected by a rising sea level. (Author's abstract) W90-06663

TRIGGER MECHANISM FOR SEDI-MENT SAMPLERS. Queen's Univ., Kingston (Ontario). Dept. of Geog-

For primary bibliographic entry see Field 7B. W90-06670

DISTRIBUTION OF PCB CONGENERS IN SEDIMENTS OF THE OTONABEE RIVER-RICE LAKE SYSTEM, PETERBOROUGH, CANADA.

CANADA.
Trent Univ., Peterborough (Ontario). Environmental and Resource Studies Program.
For primary bibliographic entry see Field 5B.
W90-06758

ANALYSIS OF THE RELATIONSHIP FOR DETERMINING THE BED LOAD IN SAND CHANNELS.

A. Bazilevich, and V. V. Kozitskii Hydrotechnical Construction HYCOAR, Vol. 23, No. 5, p 288-292, 1990. 3 fig, 14 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, pp. 47-50, May, 1989

Descriptors: *Bed load, *Channel morphology, *Hydraulic geometry, *Sand waves, *Sediment

transport, Flow velocity, Mathematical equations, Particle size

The formula established at the State Hydrological Institute of the USSR (GGI) in which the bed load acts as function of the height of sand waves in the absence of a relation between this height and the absence of a relation between this height and the sediment particle size, has recently gained wide use for determining the bed load. At the same time, many formulas are known in which the bed load is a function of the size of the sediment being trans-ported. In connection with this, the GGI relation-ship was analyzed and compared with other for-mulas, and its area of use was determined. The GGI formula makes it possible to calculate the bed load based on only two parameters of the water mean velocity and depth of the flow. The results of the analysis showed that, in flatland rivers with a sand channel and with the friction velocity of the sand channel and with the friction velocity of the flow > or = the noneroding friction velocity of the sediment, in which movement of the bed load is realized mainly in the form of steep waves and ripples, the GGI relationship, in which unit volume bed load is represented as a function of the height of the bed forms (sand waves), should be neight of the beat forms (and waves), should be used. This relationship gives results substantially different from those calculated by relationships in which unit volume bed load is expressed as a function of the size of the sediment particles and valid for conditions not characteristic of sand channels of flatland rivers. When the threshold velocity < or = the friction velocity of the flow < noneroding friction velocity of the sediment, when there is still no mass traction of all fractions of the channel deposits, the Einstein and Paintal relationships are better substantiated for all chanreationships are better substantiated for all chan-nels. However, for practical calculations for sand channels of flatland rivers it can be assumed that unit volume bed load = 0 when the friction veloci-ty of the flow is less than the noneroding friction velocity of the sediment. (Rochester-PTT)

EFFECT OF A FREE SURFACE ON THE FOR-MATION OF A WAVE BED OF A CHANNEL FLOW

A. N. Lyapin, and M. B. Polyanskaya Hydrotechnical Construction HYCOAR, Vol. 23, No. 5, p 293-297, 1990. 3 fig, 1 tab, 16 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, pp. 50-52, May, 1989.

Descriptors: *Channel morphology, *Hydrodynamics, *Open-channel flow, *Sand waves, *Sediment transport, Bed forms, Flow velocity, Free surfaces, Mathematical equations, Turbulent flow.

Analysis of the interaction of a fluid flow with a boundary, including a mobile sand layer, presently is based on consideration of the unsteady turbulent fluctuations of the velocity and pressure fields developing within the flow. The simultaneous effect on the flow of gravitational forces and low-frequency turbulent disturbances, which are periodically recurring processes, can be represented schematically by two wavy lines, one near the bottom in the form of the envelope of the sand wave and the second near the free surface with various lengths, frequencies, and amplitudes of the free surface and the bottom. The variations of the amplitude of the free surface can be very small, almost unnoticeable under laboratory and on-site conditions, but can have a great effect on the velocity structure of the flow. The changes in the bottom streamline, which to a considerable extent determines the change in a bottom riffled by sand Analysis of the interaction of a fluid flow with a determines the change in a bottom riffled by sand waves, can be completely perceptible. A clear-cut dependence of the Froude number is noted with respect to them: as it increases, the heights of the sand waves under laboratory conditions (sand diameter > 1 mm) greatly increase, for example to 360% for a ratio of frequencies = 0.85, compared 300% for a ratio of frequencies = 0.83, compared with the original heights for a ratio of frequencies = 0.3-0.4. According to the present experimental data, the lengths between wave crests (wavelength) completely satisfactorily follow the Froude numbers, increasing as the Froude number decreases. Theoretically, such a relation follows from the equality of the frequency (a) and the frequency creases. Incoretically, such a relation follows from the equality of the frequency (n) and the frequency (f) for the motion of gravity waves in shallow water. Thus, the effect of large turbulent structures

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on a channel bottom as presented here represents an orderly combination of experimental, physical, and mathematical approaches to the interaction of flow and channel. It is emphasized that account must be taken not only of the control frequency of the kinematic part of the flow, but of the second frequency related to the wave characteristic of the free surface occurring within morphological structures. (Rochester-PTT)

SEDIMENT CONCENTRATION VERSUS WATER DISCHARGE DURING SINGLE HYDROLOGIC EVENTS IN RIVERS,

Geological Survey, Denver, CO. G. P. Williams.

G. P. Williams. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 89-106, November 1989. 7 fig, 1 tab, 16 ref.

Descriptors: *Floods, *Graphical analysis, *Hy-Descriptors: 'Froots, 'Orapnical analysis, 'Trans-drology, 'Sediment discharge, 'Sediment trans-port, 'Stream discharge, Flood hydrographs, Geo-morphology, Mathematical studies, Rainfall, Tem-poral distribution, Traveltime.

Relations between sediment concentration (C) and water discharge (Q) for a hydrologic event such a flood are studied quantitatively by analyzing 'smoothed' temporal graphs (discharge and concentration vs. time) in terms of mode, spread, and skewness. Comparing C/Q ratios at a given discharge on the rising and falling limbs of the discharge hydrograph provides a consistent, reliable method for categorizing C/Q relations. Five common classes of such relations are single-valued (straight or curved), clockwise loop. counterclockmethod for categorizing C-Q relations. Five common classes of such relations are single-valued (straight or curved), clockwise loop, counterclockwise loop, single-valued plus a loop, and figure eight. Temporal-graph mode and skewness influence the type of relation, whereas temporal-graph spread affects the details of the particular C-Q relation (its graphical breadth, shape, orientation, and plotted location). Field examples of the various types of relations were analyzed. Features brought out in this study, which heretofore have received little or no attention, include: (1) the upward-bending and downward-bending C-Q curves (single-valued lines); (2) the clockwise-loop C-Q relation when sediment and water peak simultaneously; (3) the counterclockwise loop when sediment and water peak simultaneously; (4) the single-line-plus-loop relation; (5) the figure-eight relation; (6) the overall classification of C-Q relations; and the graphical explanations for each relation (C/Q ratios). C-Q relations are influenced by precipitation intensity and areal distribution, runoff amount and rate, floodwater travel rates and travel distances, spatial and temporal storage-mobilization-depletion processes of available sediment, and sediment travel rates and distances. The potential mix and interrelations of these and other variables present a formidable challenge to predicting the voe and tother variables present a formidable challenge to predicting the voe and tother variables present a formidable challenge to predicting the voe and tother variables present a formidable challenge to predicting the voe and tother variables present a formidable challenge to predicting the voe and tother variables present a formidable challenge to predicting the voe and tother variables present a formidable challenge to predicting the voe and tother variables present a formidable challenge to predicting the voe and voe variables present a formidable challenge to predicting the voe and voe variables present a formidable challenge to predicting the mix and interrelations of these and other variables present a formidable challenge to predicting the type and magnitude of C-Q relation for a particular site and occasion. (Rochester-PTT) W90-0688

INDUCED CHANNEL ENLARGEMENT IN SMALL URBAN CATCHMENTS, ARMIDALE, NEW SOUTH WALES.

Chinese Univ. of Hong Kong, Shatin. Dept. of Geography. For primary bibliographic entry see Field 4C. W90-06959

COMMON ANALYTICAL ERRORS IN THE RADIODATING OF RECENT SEDIMENTS, National Water Research Inst., Burlington (Ontario). Lakes Research Branch.

S. R. Joshi. Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 3, p 203-207, November/ December 1989. 2 fig, 2 tab, 8 ref.

Descriptors: *Error analysis, *Radiochemical analysis, *Sediment analysis, *Sedimentation rates, Cesium radioisotopes, Isotope studies, Lead radiosotopes, Mathematical models, Polonium radioiso-

Four possible sources of analytical error in the measurement of unsupported 210Pb and/or nuclear

fallout radionuclide (such as 137Cs) profiles in sediment cores are (1) Freezing the entire sediment core prior to precise sectioning; (2) Sectioning the sediment core at room temperature or lower (4 C usually) by pushing it outward using an extruder (though both of these methods can distort the profile of a radionuclide such as 137Cs due to shearing effect of the sampler and/or cover); (3) Determining 210Pb via its 5.01-day halfific beta emitting (E max=1.17 MeV) daughter 210Bi; (4) Determining 210Pb via the 138-day alpha-emitting (3.3 MeV) granddaughter 210Po. Simple procedural modifications can substantially improve the quality of analytical data that are subsequently used to develop intricate mathematical models to aid the interpretation of observed radionuclide profiles. These modifications include (1) Always store subsamples for sufficiently long periods of time to ensure equilibrium between 210Po and unsupported 210Pb; (2) Always use 208Po as yield monitor and assay autoplated sources on an alpha-particle counter since the alpha particle energies of 208Po (5.11 MeV) and 210Po (5.303 MeV) are separable only on a spectrometer using a detector such as the commonly-available silicon surface-barrier detector; (3) Never use any glassware for radiochemical work involved polonium since several polonium compounds are known to absorb onto glass surfaces. Quartz is perhaps the best choice though Teflon or similar materials are also suitable for most situations. Avoid heating above 120 C during HCI leaching and above 90 C during plating since PoCl4 is highly volatile. (Chonka-PTT)

ADSORPTION CAPACITY OF PHOSPHORUS IN BALTIC SEA SEDIMENTS. Stockholm Univ. (Sweden). Dept. of Geology. For primary bibliographic entry see Field 2K.

SEDIMENT STABILIZATION BY HALO-PHILA DECIPIENS IN COMPARISON TO OTHER SEAGRASSES, National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.

M. S. Fonseca N. S. Puliscer. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 29, No. 5, p 501-507, November 1989. 1 fig, 1 tab, 17 ref.

Descriptors: *Bottom sediments, *Erosion control, *Estuarine sediments, *Sea grasses, *Sediment control, *Sediment-water interfaces, Aquatic environment, Biomass, Ecosystems, Flumes, Plant morphology, Sediment distribution, Sediment trans-

While seagrasses are known for their sediment stabilization qualities, some genera, such as the diminutive Halophila, are not. An underwater flume was used to evaluate the threshold of sediment motion in a 20 m deep Halophila decipiens bed. Results were compared to unvegetated sand and seagrasses elsewhere. Despite having substantially smaller leaves and leaf biomass than other seagrass species, H. decipiens increases the threshold velocity for sediment motion significantly as compared to sand, and was similar to threshold velocity effects by larger seagrasses. Allocation of leaf biomass and rhizomes closer to the sediment-water interface than observed for other seagrasses was hypothesized as the primary physical basis for the sediment stabilization effects provided by this species. (Author's abstract)

PORE WATER CHEMISTRY OF RARE EARTH ELEMENTS IN BUZZARDS BAY SEDIMENTS. Woods Hole Oceanographic Institution, MA. E. R. Sholkovitz, D. J. Piepgras, and S. B.

Geochimica et Cosmochimica Acta GCACAK, Vol, 53, No. 11, p 2847-2856, November 1989. 5 fig, 5 tab, 33 ref. NSF Grants OCE-85-113910 and

Descriptors: *Buzzards Bays, *Geochemistry, *Marine sediments, *Pore water, *Rare earth elements, *Sediment chemistry, *Trace elements,

Bottom sediments, Chemical properties, Cores, Leaching, Phosphorus.

A 72 cm deep pore water profile of rare earth elements (REE) is presented from Buzzards Bay, Mass., sediments. This profile shows large enrichments of all REE in the upper half followed by the preferential removal of light and middle REE in the lower part of the core. As such, this study (1) confirms earlier observations from a 30 cm profile that REE undergo active diageness in Buzzards contirms earlier observations from a 30 cm profile that REE undergo active diageness in Buzzards Bay sediments and (2) provides new data to show that removal and fractionation occur upon further burial and diagenesis. In the upper half of the core, the diagenetic input of REE into pore waters is accompanied by the preferential release of light REE (LREE) and middle REE (MREE) relative REE (LREE) and middle REE (MREE) relative to heavy REE (HREE). At their maximum near 40 cm, pore water concentrations reach values 10-20 times (30 times for Ce) those of bottom water. times (30 times for Ce) those of bottom water. Between 40 and 70 cm, the concentrations of La through Gd decrease by 50% while Er and Yb decrease by only 25% and Lu shows no decrease. Hence, both the production and removal of REE results in significant fractionation. Positive Ce anomalies are restricted to the upper 9 cm; at greater depths the Ce profile tracks that of other trivalent neighbors (La, Nd). A mild leach of sediments with 0.3 M HCl showed that a large fraction of REE and P are released (30-40% and 60%, respectively) to solution while the percentage was only 4% for Al. While phosphatic phases are important carriers of REE in marine sediments, their only 4% for Al. While phosphatic phases are important carriers of REE in marine sediments, their link to diagnesis and pore water chemistry remains to be solved. (Author's abstract) W90-07008

ORGANIC GEOCHEMISTRY AND BRINE COMPOSITION IN GREAT SALT, MONO, AND WALKER LAKES.

Johns Hopkins Univ., Baltimore, MD. Dept. of Earth and Planetary Sciences. J. L. Domagalski, W. H. Orem, and H. P. Eugster.

Geochimica et Cosmochimica Acta GCACAK, Vol, 53, No. 11, p 2857-2872, November 1989. 10 fig, 6 tab, 44 ref.

Descriptors: *Brines, *Geochemistry, *Lake sediments, *Oil shale, *Saline lakes, *Sediment chemisments, Voil shale, *Saline lakes, *Sediment chemis-try, *Sedimentology, Algae, Anaerobic processes, Aquatic environment, Biomass, Bottom sediments, Decomposing organic matter, Detritus, Diagenesis, Ecosystems, Great Salt Lake, Mono Lake, Organic carbon, Organic matter, Trace elements, Walker

mples of recent sediments, representing up to Samples of recent settification, were collected form three closed basin lakes (Mono Lake, CA, Walker Lake, NV, and Great Salt Lake, UT) to assess the effects of brine composition on the accumulation of entects of the composition on the accumulation of dis-solved organic carbon, the concentration of dis-solved organic carbon, humic acid structure and diagenesis, and trace metal complexation. The Great Salt Lake water column is a stratified Na-Mg-Cl-SO4 brine with low alkalinity. Algal debris entrained in the high density (1.132-1.190 g/cc) bottom brines, and in this region maximum organic matter decomposition occurs by anaerobic process-es, with sulfate ion as the terminal electron accepes, with sulfate ion as the terminal electron acceptor. Organic matter, below 5 cm of the sediment-water interface, degrades at a very slow rate in spite of very high pore-fluid sulfate levels. The organic carbon concentration stabilizes at 1.1 wt%. Mono Lake is an alkaline (Na-CO3-CI-SO4) system. The water column is stratified, but the bottom brines are of lower density relative to the Great Salt Lake, and sedimentation of algal debris rapid. Depletion of pore-fluid sulfate, near 1 m of core, results in a much higher accumulation of organic carbon, approximately 6 wt%. Walker Lake is also an alkaline system. The water column is not stratified, and decomposition of organic carus by aerobic processes at the sedimeter occurs by aerobic processes at the sedimatter occurs by aerobic processes at the sedi-ment-water interface and by anaerobic processes below. Total organic carbon and dissolved organic carbon concentrations in Walker Lake sediments vary with location and depth due to changes in input and pore-fluid concentrations. Nuclear mag-letic resonance studies (13C) of humic substances and dissolved organic carbon provide information

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on the source of the Recent sedimentary organic on the source of the Recent sedimentary organic carbon (aquatic vs. terrestrial), its relative state of decomposition, and its chemical structure. The spectra suggest an algal origin with little terrestrial signature at all three lakes. The dissolved organic carbon of the Mono Lake pore fluids is structurally related to humic acid and is also related to carbo-hydrate metabolism. (Author's abstract) W90_07009

HYDRAULIC RESISTANCES OF DEFORMA-BLE CHANNELS AND THEIR STABILITY

For primary bibliographic entry see Field 8B. W90-07048

VELOCITY OF PARTICLES FALLING IN VER-TICALLY OSCILLATING FLOW.

Delaware Univ., Lewes. Air-Sea Interaction Lab. Delaware Only, Eewes, Arr-Sea Interaction Lab.

Journal of Hydraulic Engineering (ASCE)

JHEND8, Vol. 116, No. 1, p 23-35, January 1990.

4 fig, 1 tab, 9 ref.

Descriptors: *Fall velocity, *Flow velocity, *Fluid mechanics, *Numerical analysis, *Sedimentation, *Vertical flow, Flow characteristics, Fourier analysis, Least squares method, Reynolds nur

The instantaneous velocity of particles driven by an oscillating flow can be determined by means of an oscillating flow can be determined by means of Fourier analysis. A simple numerical method based on the principle of least square error is presented to obtain the solutions of the Fourier coefficients. The computed zeroeth harmonic term, which is the effective fall velocity and is less than the terminal velocity in still fluid, was in good agreement with experimental observations. The reduced velocity is caused by the nonlinear modification of the drag force exerted on the particle by the fluid because the relative velocity between the particle and the fluid is no longer the constant terminal velocity. There are three parameters that detervelocity. There are three parameters that determine the effectiveness of fall velocity reduction: the terminal velocity Reynolds number, the ratio of the flow velocity to the terminal velocity, and a quantity characterizing the frequency response of the particle to the unsteadiness of the flow motion. (Author's abstract) W90-07065

HYPERCONCENTRATED SAND-WATER MIX-TURE FLOWS OVER FLAT BED.
Waterloopkundig Lab. te Delft (Netherlands).

J. C. Winterwerp, M. B. de Groot, D. R. Mastbergen, and H. Verwoert. Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 1, p 36-54, January 1990.

11 fig. 1 tab, 27 ref.

Descriptors: *Erosion, *Fluid mechanics, *Hydraulic properties, *Sediment distribution, *Sediment transport, *Sedimentation, *Solute transport, *Viscous flow, Density stratification, Flow velocity, Laminar flow, Sand, Turbulent flow.

Field surveys and experiments in two tilting flumes on hyperconcentrated sand-water-mixture (swm) flows were conducted. It is shown that an equilibrium slope can be defined at which sedimentation and erosion are in balance. For laminar flow condiand crosson are in obtained. For hammar now condi-tions, this slope is only dependent on the average sand concentration, whereas for turbulent condi-tions the flow rate per unit width is the main parameters. The sand concentration near the bed measured about 35% by volume for most test neasured about 35% by volume for most test conditions. The vertical gradient in sand concentration decreased with increasing mean sand concentration, indicating a decrease in the damping of turbulence. The velocity distribution behaved fairly logarithmically, showing a variation in slope with varying sand concentration. A minimum value of the effective von Karman constant was found at concentrations of about 20%. Finally, it appears plausible that at high concentrations, a considerable growth of the viscous sublayer occurs, resulting in an increase in bed shear stress. (Author's abstract) (Author's abstract)

HYDRAULIC DESIGN OF ERODIBLE-BED

San Diego State Univ., CA. Dept. of Civil Engineering. For primary bibliographic entry see Field 8B. W90-07069

FAIRWEATHER VERSUS FLOOD SEDIMEN-TATION IN MHLANGA LAGOON, NATAL: IMPLICATIONS FOR ENVIRONMENTAL MANAGEMENT

National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.

J. A. G. Cooper. South Africa Journal of Geology SAJGET, Vol. 92, No. 3, p 279-294, September 1989. 10 fig, 1 tab, 50 ref.

Descriptors: *Bottom sediments, *Brackish water, *Lagoons, *Mud, *Sediment distribution, *Sedimentation, Dunes, Lake morphology, Marl, Sediment erosion, Sedimentology, South Africa.

The Mhlanga River joins a small, brackish-water lagoon separated from the Indian Ocean by a continuous barrier. The sedimentary erosion of this lagoon and its probable causes were studied. Sedilagoon and its probable causes were studied. Seniments in the present lagoon accumulated during and since the Flandrian Transgression and the lagoon probably had a greater open-water area several thousand years ago. The lagoon has shown little morphological change over the past 50 years, suggesting that a state of dynamic equilibrium has now been reached between sediment accumulation when the lagoon is closed and sand scour when its mouth is open. Modern lagoonal sediments include marine sand derived by barrier overwash and catchment-derived sediment comprising mainly catchment-derived sediment comprising mainly ine-grained sand and mud. Erosion of surrounding sediments, including acolian dunes, contributes a minor portion of the lagoonal sediment. Mud is deposited from suspension in areas where wave action is restricted. The lagoonal sediments have an average organic content of about 2%. Current velocities are too low to initiate sediment motion velocities are too low to initiate sediment motion and consequently sedimentation occurs by barrier overwash, in situ organic production, and hill wash from surrounding areas. Severe floods in September 1987 provided the opportunity to study the effect of high discharge of sediment erosion and deposition. Under flood conditions, a mouth is formed through the barrier and the river discharges in the Indian Ocean. During flood conditions, estimated current velocities are capable of tions, estimated current velocities are capable of transporting only fine-grained sand and mud. An ephemeral delta is formed in the ocean and suspended sediment is transported seaward. The mouth closes rapidly due to littoral drift and wave action and the lagoon again fills with water. The major management concern in the Mhlanga Lagoon is the erosion of vegetated dunes both at the northern and southern ends of the sandbar. It is suggested that, at the northern end of the lagoon access to the beach via the base of the dune should be prohibited. This will prevent dune erosion and help maintain the near-natural condition of the lagoon. A boardwalk could be constructed if demand warranted such a step. (Author's abstract)

MODELING COASTAL LANDSCAPE DYNAM-

Maryland Univ., Solomons. Chesapeake Biological For primary bibliographic entry see Field 4C. W90-07136

POLYCHLORINATED BIPHENYLS (PCBS) IN SEDIMENTS IN HONG KONG: A CONGENER-SPECIFIC APPROACH TO THE STUDY OF COPLANAR PCBS IN AQUATIC ECOSYS-TEMS

Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation. For primary bibliographic entry see Field 5B. W90-07197

DISCHARGE OF SEDIMENT IN CHANNEL-IZED ALLUVIAL STREAMS.

Geological Survey, Nashville, TN. Water Resources Div.

A. Simon.
Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1177-1188, December 1989. 6 fig, 6 tab, 25 ref.

Descriptors: *Alluvial channels, *Channeling, *Geomorphology, *Sediment discharge, *Sediment yield, *Stream erosion, Channel morphology, Mississippi River, Streams, Suspended sedim

Approximately 400 million cubic feet of channel sediments have been delivered to the Mississippi River from the Obion-Forked Deer River system in the last 20 years. The discharge of sediment from these channelized networks in West Tennes-see varies systematically with the stage of channel evolution. Variations in yields over time reflect the shifting dominance of fluvial and mass-wasting shifting dominance of fluvial and mass-wasting processes as the networks adjust to lower energy conditions. Maximum bed-material discharges occur during the initial phases of degradation (Stage III). In contrast, yields of suspended-sediment peak during the threshold stage (Stage IV: large-scale mass wasting) as sediments are delivered from main-channel banks and tributary beds. ered from main-channel banks and tributary beds. Suspended-sediment yields then decrease as aggradation (Stage V) becomes the dominant trend in the main channels, but remains relatively high through restabilization (Stage VI) because of continued degradation and widening in the tributaries. Bed-material discharges decrease from the degradation Stage (III) to Stage V, and decrease again during restabilization (Stage VI) because secondary aggradation increases gradients and incipient meandering serves to rework bed sediments. This secondary maximum in bed-material discharge is analogous to those described previously as comsecondary maximum in bed-material discharge is analogous to those described previously as com-plex, or oscillatory, response. The trends of sedi-ment production and transport described from these rejuvenated networks are in agreement with experimental and theoretical results of earlier investigations. (Author's abstract) W90-07207

ESTIMATION OF POTENTIAL REDUCTIONS IN RECREATIONAL BENEFITS DUE TO SEDIMENTATION.

Salisbury State Coll., MD. Perdue School of Busi-

For primary bibliographic entry see Field 4C. W90-07215

COMPARISON OF EROSION AND WATER POLLUTION CONTROL STRATEGIES FOR AN AGRICULTURAL WATERSHED.

Missouri Univ.-Columbia. Dept. of Agricultural Economics. For primary bibliographic entry see Field 5G. W90-07350

FREEZE-CORING TECHNIQUE APPLIED TO POLLUTION BY FINE SEDIMENTS IN GRAVEL-BED RIVERS.

Dept. of Geography.

For primary bibliographic entry see Field 5A.

W90-07399

ORGANOCHLORINE COMPOUNDS AND PCB CONGENERS IN CONTAMINATED SEDI-MENTS.

Commission of the European Communities, Ispra (Italy). Radiochemistry and Nuclear Chemistry For primary bibliographic entry see Field 5B. W90-07403

2K. Chemical Processes

MEASUREMENT OF BACTERIAL SULFATE REDUCTION IN SEDIMENTS: EVALUATION OF A SINGLE-STEP CHROMIUM REDUCTION METHOD.

Aarhus Univ. (Denmark). Inst. of Ecology and

Chemical Processes—Group 2K

H. Fossing, and B. B. Jorgensen. Biogeochemistry BIOGEP, Vol. 8, No. 3, p 205-222, November 1989. 3 fig, 3 tab, 38 ref. Danish Natural Science Research Council grants 11.5736, 11.6308, and 11.6711.

Descriptors: *Analytical techniques, *Chemical analysis, *Laboratory methods, *Radioactivity techniques, *Sediment chemistry, *Sulfur, Chemical properties, Comparison studies, Distillation. *Chemical

A procedure that includes the Total Reduced Inorganic Sulfur in a single distillation step is used for the radiotracer measurement of sulfate reduction in sediments. ments. The Total Reduced Inorganic Sulfur ades both Acid Volatile Sulfide (H2S + FeS) and the remaining Chromium Reducible Sulfur (S0, FeS2). The single-step distillation was simpler and faster than the consecutive distillations of Acid and faster than the consecutive distillations of Acid Volatile Sulfide and Chromium Reducible Sulfur. It also resulted in higher (4-50%) sulfate reduction rates than those obtained from the sum of 355 in Acid Volatile Sulfide and Chromium Reducible Sulfur. The difference was largest when the sediment had been dried after Acid Volatile Sulfide, but before Chromium Reducible Sulfur distillation. Relative to the 355-Acid Reducible Sulfur distillation. Relative to the 35S-Acid Reducible Sultur distilla-tion alone, the 35S-Total Reduced Inorganic Sulfur single-step distillation yielded 8-87% higher reduction rates. The separation and recovery of FeS, SO and FeS2 was studied under three distilla-FeS, S0 and FeS2 was studied under three distillation conditions: (1) cold acid, (2) cold acid with Cr (++), and (3) hot acid with Cr(++). The FeS was recovered by cold acid alone, while pyrite was recovered by cold acid with Cr(++). A smaller S0 fraction, presumably of the finer crystal sizes, was recovered also in the cold acid with Cr(++), while most of the S0 required hot acid with Cr(++) for reduction to H2S. (Author's abstract) W90-06555

FACTORS CONTROLLING THROUGHFALL CHEMISTRY IN A BALSAM FIR CANOPY: A MODELING APPROACH.

New York Botanical Garden, Bronx, NY, Inst. of tem Studie

Ecosystem Studies. G. M. Lovett, W. A. Reiners, and R. K. Olson. Biogeochemistry BIOGEP, Vol. 8, No. 3, p 239-264, November 1989. 10 fig, 1 tab, 26 fef. National Science Foundation grant BSR-8036228.

Descriptors: *Ammonium, *Chemistry of precipitation, *Coniferous forests, *Forest hydrology, *Model studies, *Potassium, *Throughfall, *Water chemistry, Hydrologic models, Precipitation, Rainfall, Water level fluctuations.

A model of water flux and throughfall concentra-tions of K(+) and NH4(+) was created for a subalpine balsam fir forest. The model is based on a multi-layer submodel of hydrologic flow. Cloud water deposition and evaporation are incorporated as separate submodels. Chemical exchange is para-meterized with diffusion resistances and internal as separate submodels. Chemical exchange is parameterized with diffusion resistances and internal foliar concentrations determined from leaching experiments on isolated canopy components. The model was tested against within-storm throughfall measurements and found to agree reasonably well in most instances. Some specific departures from observed data were noted, of which some can be explained. Differences between observed and modeled concentrations of K(+) early in the storm events suggested that pre-storm conditions that were not modeled, were important in controlling the chemical exchange. Responses of throughfall chemistry to changes in rain rate, rain concentration, and stand surface area index were investigated by simulation with the model. Increasing rain rates increased elaching of K(+) and uptake of NH4(+). Increased slightly the amount of K(+) leached, but increasing concentrations of NH4(+) in rain increased NH4(+) uptake proportionately. Increasing canopy surface area index increased the leaching of K(+) and the uptake of NH4(+), with the pattern of the increase dependent on rain rate. (Author's abstract)

DYNAMICS OF SILICA IN A SHALLOW, DIATOM-RICH SCOTTISH LOCH: I. STREAM INPUTS OF THE DISSOLVED NUTRIENT.

Institute of Terrestrial Ecology, Edinburgh (Scotland). For primary bibliographic entry see Field 2H. W90-06576

DYNAMICS OF SILICA IN A SHALLOW DIATOM-RICH SCOTTISH LOCH: II. THE IN-FLUENCE OF DIATOMS ON AN ANNUAL RUDGET

Institute of Terrestrial Ecology, Edinburgh (Scotland). For primary bibliographic entry see Field 2H. W90-06577

ACID DEPOSITION, SUMMER DROUGHT AND ENHANCED PRODUCTION OF NI-TRATE IN FOREST SOILS; RISK COFACTORS RELATIVE TO FOREST DECLINE. AN ADDI-TIONAL HYPOTHESIS CONCERNING THE SYNERGISTICAL EFFECTS: THE NITROUS

Association pour la Prevention de la Pollution Atmospherique, Bordeaux (France). For primary bibliographic entry see Field 2B. W90-06619

IN-SITU EXPERIMENTS ON CHANGES OF SOLID HEAVY METAL PHASES IN AEROBIC AND ANAEROBIC GROUNDWATER AQUIFERS.

AQUIFERS, Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik. For primary bibliographic entry see Field 5B. W90-06624

NITROGEN BUDGET IN THE EUPHOTIC ZONE OF LAKE BIWA FROM SPRING TO SUMMER, 1986. Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 2H. W90-06674

COMPOSITION OF PHOTOSYNTHETIC PRODUCTS IN LAKE BIWA, JAPAN; VERTICAL AND SEASONAL CHANGES AND THEIR RELATION TO ENVIRONMENTAL FACTORS. Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 2H. W90-06675

CONTINENTAL FLUXES TO THE BAY OF BISCAY: PROCESSES AND BEHAVIOUR.
Institut de Geologie du Bassin d'Aquitaine, Ta-(France).

J.M. Jouanneau, and C. Latouche.
Ocean and Shoreline Management OSMAE6, Vol.
21, No. 5/6, p477-485, 1989. 4 fig, 16 ref.

Descriptors: *Continental shelf, *Estuaries, *Geochemistry, *Sediment transport, *Solute transport, Bays, Dissolved solids, Marine environment, Par-

Continental inputs of dissolved materials and particulates from the Gironde estuary to the Bay of Biscay are the largest of the French Atlantic coast. In order to study, through a pluridisciplinary research program, the ecosystems of continental shelves, the main characteristics of the Bay of Biscay are presented. The relationships between continental fluxes and the shelf are summarized. The main characteristics of the shelf on the French heat of the Bay of Biscay are those of a macrotidal. part of the Bay of Biscay are those of a macrotidal shelf subject to strong dynamic conditions; the shelf subject to strong dynamic conditions; the large inputs of the biggest estuary of the western Atlantic coast, the Gironde, provide a good example for the study of the behavior of matter and energy fluxes to the shelves and later to the ocean. More research is needed on the identification, extent, frequency and quantification of the continental influence. An important point is to determine the relationships with the biological cycle, both in surface waters and in the bottom sediments; and to determine the relationships with the biological cycle, both in surface waters and in the bottom sediments; and to examine if and how the variabilisediments; and to examine if and how the variability of the different continental fluxes is recorded in e surficial sediment layer. (Author's abstract)

W90-06688

HYDROCHEMISTRY AND POLLUTION STATUS OF SOME KASHMIR HIMALAYAN LAKES.

Kashmir Univ., Srinagar (India). Centre of Re-search for Development. For primary bibliographic entry see Field 5B. W90-06690

TRANSFORMATIONS OF NITROGEN FORMS IN EPILIMNION OF EUTROPHIC GLEBOKIE LAKE (MASURIAN LAKE DISTRICT, POLAND).

Polish Academy of Sciences, Lomianki, Inst. Ekologii. For primary bibliographic entry see Field 2H. W90-06691

FATE OF SOME CRUDE OIL RESIDUES IN SEDIMENTS.

Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.

W90-06744

ORGANOCHLORINE COMPOUNDS AND BROMODIPHENYLETHERS IN LIVERS OF ATLANTIC COD (GADUS MORHUA) FROM THE NORTH SEA, 1977-1987. Rijksinstituut voor Visserijonderzoek, Ijmuiden (Netherlands).

For primary bibliographic entry see Field 5B. W90-06745

DISTRIBUTION OF POLYCHLORINATED BI-PHENYLS IN WATER, SEDIMENT AND BIOTA OF TWO HARBOURS. National Water Research Inst., Burlington (Ontar-io). Lakes Research Branch. For primary bibliographic entry see Field 5B. W90-06746

METHOD FOR THE DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN PROCESSED WASTEWATER AT THE PARTS PER QUADRILLION LEVEL. Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab. For primary bibliographic entry see Field 5A. W90-06750

POTENTIAL UNDERESTIMATION OF CHLORINATED HYDROCARBON CONCEN-TRATIONS IN FRESH WATER.

NATIONS IN FRESH WATER, National Water Research Inst., Burlington (Ontar-io). Rivers Research Branch. For primary bibliographic entry see Field 5A. W90-06755

ASSESSMENT OF THE TRANSPORT OF AT-MOSPHERIC CO2 INTO THE ARCTIC OCEAN,

Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemis-Goeteborg

try.
L. G. Anderson, and D. Dyrssen.
Journal of Geophysical Research (C) Oceans
JGRCEY, Vol. 95, No. 2, p 1701-1711, February
15, 1990. 4 fig, 1 tab, 30 ref.

Descriptors: *Arctic Ocean, *Carbon dioxide, *Geochemistry, *Oceanography, Alkalinity, Atmospheric carbon dioxide, Calcium, Carbonates, Mixing, Salinity, Temperature.

Data on concentration of total carbonate together with calcium, total alkalinity, salinity, and temperwith calcium, total alkalinity, salinity, and temper-ature from the Canadian Expedition to Study the Alpha Ridge (CESAR) Ice Camp, the Ymer 80 expedition and the 1984 F. S. Polarstern Marginal Ice Zone Experiment (MIZEX 84) are used to assess the transport of carbon dioxide into the different water masses of the Arctic Ocean. Most of this carbon dioxide goes into the surface mixed

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layer and halocline waters. A small flux to the Atlantic layer is discernible. No flux to the deep water could be observed. It is possible to separate water could be observed. It is possione to separate the carbon input to the Arctic Ocean into three components: carbon from the atmosphere fixed in river drainage basins (20 to 60 teragrams C/yr), a similar amount of carbon from dissolved mineral calcium carbonate in river drainage basins and carbon from the atmosphere fixed over the continental shelves (64 to 194 teragrams C/yr). From nential sterves (ed to 194 cetagrams Cyry). From these data the transport of decayed organic carbon from the tundra to the Arctic Ocean and the 'new production' 25 to 65 g C/sq m/yr for biogenic carbon over the continental shelves of the Arctic Ocean was estimated. (Author's abstract) W90-06801

RESIDENCE TIMES FOR CD AND PO4 IN FUNKA BAY, JAPAN.
Hokkaido Univ., Sapporo (Japan). Dept. of Chem-

K. Abe, K. Kuma, I. Kudo, and K. Matsunaga.

Marine Chemistry MRCHBD, Vol. 28, No. 4, p
325-331, January 1990. 3 fig, 1 tab, 11 ref.

Descriptors: *Cadmium, *Cycling nutrients, *Japan, *Phosphates, *Water chemistry, Funka Bay, Organic matter, Residence time, Seasonal variation, Sediment trap, Water depth.

The fluxes of cadmium and phosphate were measured during the summer using a sediment trap moored in Funka Bay. These fluxes were corrected with a phytoplankton decomposition rate constant obtained by a laboratory experiment because of decomposition of organic matter in the trap. The residence times for cadmium and phosphate in the bay were calculated by dividing their standing only were calculated by dividing their standing stocks in the water column by the corrected fluxes, on the assumption that cadmium and phosphate are at steady-state during the summer. The calculated residence times for cadmium and phosphate in the 0-40 m depth interval were 117 and 58 days in 0-40 m depth interval were 117 and 38 days in 1985, and 124 and 50 days in 1987, respectively. The residence time for cadmium was approximately twice as long as that for phosphate. These values were in good accordance with the results previously obtained from the uptake rate constants of cadmium and phosphate in the bay. These results also ideate that the results are suffered to the constants. sults also indicate that the uptake rates of cadmium and phosphate by phytoplankton in the euphotic zone reflect the residence times for these elements. (Author's abstract) W90-06802

CHEMICAL PROPERTIES OF A LOW-OXYGEN WATER COLUMN IN PORT HACK-ING (AUSTRALIA): ARSENIC, IODINE AND

NUTRIENTS.
Melbourne Univ., Parkville (Australia). Marine Chemistry Lab.
J. D. Smith, and E. C. V. Butler.
Marine Chemistry MRCHBD, Vol. 28, No. 4, p 353-364, January 1990. 3 fig, 1 tab, 45 ref.

Descriptors: *Arsenic, *Australia, *Chemical properties, *Geochemistry, *Iodine, *Nutrients, *Oceanography, *Water chemistry, Ammonia, Dissolved oxygen, Nitrates, Nitrites, Orthophosphates, Port Hacking, Salinity, Sediment-water interfaces, Silicates, Temperature.

In a study of a water column in a basin of the South West Arm of Port Hacking, changes in dissolved oxygen, temperature and salinity were determined for several weeks. When there was <1 ml/L oxygen in the bottom water, the water column was sampled to study the vertical distribu-tion of dissolved nutrients (ammonia, nitrate, nitrite, orthophosphate and reactive silicate) and the oxidized and reduced forms of arsenic and iodine. Oxalized and reduced forms of arsenic and lodinic. Results showed that changes in the water column were dominated by inputs of these elements from the anoxic sediment. Near-bottom waters were enriched in all nutrients, arsenate and iodide. The sedimentary input of iodine was as the reduced species, I(-), but the increased arsenic in the bottom research in the bottom in the cavidated forms. A(A). The conwaters was in the oxidized form, As(V). The authors were unable to distinguish whether AS(III) diffused from the sediments and was rapidly oxidized to As(V) in the overlying waters; or AS(V),

possibly as thioarsenate, diffused across the sediment-water interface. In the oxygen-depleted waters, some I(-) is also derived from reduction of iodate in the water column. (Author's abstract)

VARIATION IN ADIRONDACK, NEW YORK, LAKEWATER CHEMISTRY AS FUNCTION OF SURFACE AREA.

E and S Environmental Chemistry, Inc., Corvallis,

OR.
T. J. Sullivan, D. L. Kugler, M. J. Small, C. B.
Johnson, and D. H. Landers.
Water Resources Bulletin WARBAQ, Vol. 26, No.
1, p 167-176, February 1990. 8 fig, 1 tab, 29 ref.
EPA Contract No. 68-C8-0006.

Descriptors: *Acid lakes, *Acid neutralizing capacity, *Acid rain effects, *Adirondack Mountains, *New York, Calcium, Organic carbon, Surface area, Water chemistry.

Data from a recent survey conducted by the Adirondack Lake Survey Corporation were used to evaluate the influence of lake surface area on the acid-base status of lakes in Adirondack State Park. New York. Acid neutralizing capacity (ANC) in New York. Acid neutralizing capacity (ANC) in the small lakes (<4 ha) occurred more frequently at extreme values (>200, <0 microeq/L), whereas larger lakes tended to be intermediate in ANC. Consequently, acidic (ANC less than or equal to 0) and low-pH lakes were typically small. The small lakes also exhibited lower ionic calcium concentration and higher dissolved organic carbon than did larger lakes. Lakes greater than or equal to 4 ha were only half as likely to be acidic as were lakes creater than or equal to 1, ba in sea. These data greater than or equal to 1 ha in area. These data illustrate the dependence of lake chemistry on lake surface area and the importance of the lower lake area limit for a statistical survey of lakewater chemistry. (Author's abstract) W90-06833

BIOGEOCHEMICAL CYCLES IN FORESTS OF THE SIERRA DE BEJAR (SALAMANCA, SPAIN): RETURN OF BIOELEMENTS IN

Instituto de Microbiologia Bioquimica, Salamanca

Acta Oecologia, Oecologia Plantarum AOSPDY, Vol. 10, No. 4, p 433-438, 1989. 2 tab, 9 ref.

Descriptors: *Chemistry of precipitation, *Cycling nutrients, *Forest ecosystems, *Forests, *Geo-chemical cycles, *Spain, Calcium, Carbon, Copper, Iron, Magnesium, Manganese, Nitrogen, Phosphorus, Pine trees, Potassium, Rainfall, Sierra de Bejar, Sodium, Stemflow, Zinc.

The annual return of bioelements by rainfall was estimated in a repopulated forest of Scots pine (Pinus sylvestris L.) in the Candelario Basin, central Spain. Of all the elements contributed to the soil in rainwater, most of the C, N, P, Ca, K, Na, and Zn entered the soil via throughfall, whereas only 10% of the elements entered by stemflow. Eighty-two percent of the Mg reaches the soil via Eighty-two percent of the Mg reaches the soil via throughfall and the rest by stemflow; the percent-ages of Mn and Fe entering by throughfall were 70% and 30%, respectively. In contrast, more than 60% of copper enters by stemflow. During the study period (27 April 1984-6 November 1986), 1040 mm of rainfall fell on the site, whereas throughfall was 825 mm. It was estimated that elements were contributed to the soil at the following annual rates: C 114 kg/ha; N 14.2 kg/ha; Ca, 2.9 kg/ha; Mg 1.1 kg/ha; P 0.31 kg/ha; K 6.63 kg/ha; Na 0.87 kg/ha; Mn 0.96 kg/ha; Fe 0.49 kg/ha; Cu 0.013 kg/ha; and Zn 1.7 kg/ha. (Rochester-W90-06861

COORDINATION CHEMISTRY AND SPECIA-TION OF AL(III) IN AQUEOUS SOLUTION, Texas A and M Univ., College Station. Dept. of

For primary bibliographic entry see Field 7B.

SPECIATION METHOD FOR PARTITIONING MONONUCLEAR AND POLYNUCLEAR ALUMINUM USING FERRON.

Oak Ridge National Lab., TN. Environmental Sciences Div For primary bibliographic entry see Field 5A.

W90-06931

MODELING THE INTERACTIONS OF AL SPECIES, PROTONS AND CA(2+) WITH HUMIC SUBSTANCES IN ACID WATERS AND SOILS.

Freshwater Biological Association, Ambleside (England).

For primary bibliographic entry see Field 5B. W90-06933

CHEMISTRY AND TRANSFER OF ALUMINUM IN A FORESTED WATERSHED IN THE ADIRONDACK REGION OF NEW YORK, USA. Institute for Ecosystem Studies, Millbrook, NY. For primary bibliographic entry see Field 5B. W90-06934

EPISODIC VARIATIONS IN STREAMWATER ALUMINUM CHEMISTRY AT BIRKENES, SOUTHERNMOST NORWAY. Senter for Industriforskning, Oslo (Norway). For primary bibliographic entry see Field 5B. W90-06936

GLOBAL WATER CYCLE: GEOCHEMISTRY AND ENVIRONMENT,

Yale Univ., New Haven, CT. For primary bibliographic entry see Field 2A.

DETERMINATION OF TRACE LEVELS OF HERBICIDES AND THEIR DEGRADATION PRODUCTS IN SURFACE AND GROUND WATERS BY GAS CHROMATOGRAPHY/ION-TRAP MASS SPECTROMETRY.

Geological Survey, Denver, CO. For primary bibliographic entry see Field 5A. W90-06987

DETERMINATION OF HYPOCHLORITE IN WATERS BY STOPPED-FLOW CHEMILU-MINESCENCE SPECTROMETRY.

Cordoba Univ. (Spain). Dept. of Analytical Chem-

For primary bibliographic entry see Field 5A. W90-06988

FLOW-INJECTION ULTRAVIOLET SPECTRO-PHOTOMETRIC DETERMINATION OF SUL-PHATE IN NATURAL WATERS.
Warsaw Univ. (Poland). Dept. of Chemistry

For primary bibliographic entry see Field 5A. W90-06989

ADSORPTION CAPACITY OF PHOSPHORUS IN BALTIC SEA SEDIMENTS.

Stockholm Univ. (Sweden). Dept. of Geology. R. Carman, and F. Wulff. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 29, No. 5, p 447-456, November 1989. 2 fig, 3

Descriptors: *Adsorption, *Baltic Sea, *Cycling nutrients, *Marine sediments, Anaerobic conditions, Bottom sediments, Ecosystems, Eutrophication, Phosphates, Phosphorus.

Nutrient budgets of the Baltic Sea indicate that an increased loading of phosphorus to a great extent is counteracted by adsorption to the sediments, resulting in a comparatively small net increase of the phosphorus-concentration in the water column. The permanent salimity stratification and increasing eutrophication of this sea has caused almost permanent anoxic conditions which limit the phosphorusstorage capacities in the deep basins below the halocline. The phosphorus-loading has increased

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about eight-fold during this century and does not show any sign of declination. An investigation was conducted to determine what type of sediments store the phosphorus, and to determine the binding mechanisms and whether the maximum storage capacity is reached. The phosphorus adsorption capacities of three different Baltic Sea sediments were thus investigated. The greatest amount of adsorbed phosphorus, measured as mol/g dry substance, was found for an accumulation bottom from the deeper part of the Baltic Sea and the lowest for a transportation bottom above the halocine. However, if the rates are recalculated as phosphorus adsorption per area, which is more pertinent from an ecological point of view, most phosphorus is adsorbed in the shallow sediments. A comparison of the experimental data and ambinent conditions in the water and sediments indicate that adsorption of phosphate from the water column plays a minor role in the phosphorus budget of the Baltic Sea. Only the assimilation of phosphate and subsequent sedimentation and decomposition of organic matter at the sediment surface will result in a sufficiently high sediment pore water concentration to explain the large sink of phosphorus to the Baltic Sea sediments cilculated from input and output data. (Author's abstract) W90-07003

TIGHT COUPLING BETWEEN ENRICHMENT OF IRON AND MANGANESE IN NORTH SEA SUSPENDED MATTER AND SEDIMENTARY REDOX PROCESSES: EVIDENCE FOR SEA-SONAL VARIABILITY

NUNAL VARIABILITY.

Vrije Univ., Brussels (Belgium).

F. Dehairs, W. Baeyens, and D. Van Gansbeke.

Estuarine, Coastal and Shelf Science ECSSD3,

Vol. 29, No. 5, p 457-471, November 1989. 4 fig, 3

tab, 46 ref. Belgium CEC contracts ENV-555-B,

and ENV-766-B.

Descriptors: *Bottom sediments, *Cycling nutrients, *Enrichment, *Iron, *Manganese, *North Sea, *Oxidation-reduction potential, *Suspended load, Aluminum, Biomass, Ecosystems, Heavy metals, Phytoplankton, Seasonal variation, Trace

metals, Phytoplankton, Seasonal variation, Trace elements.

Suspended matter and sediments from the North Sea were analyzed for Al, Fe and Mn. A seasonal variation of Mn and Fe over Al ratios was observed. For most of the year suspended matter is enriched in Mn and Fe relative to average soil composition. No enrichment, and even depletion, occurs during a short period of the year (April-May) coinciding with the occurrence of the spring phytoplankton bloom. Surface sediments from the Southern Bight show the inverse image, with Mn and Fe enrichment occurring only in April-May and no enrichment during the rest of the year. These observations suggest a tight coupling between: (1) the change of redox potential in surface sediments, as triggered by the advection of organic matter from the spring bloom; (2) the outflow of reduced iron and manganese from sediments to the watercolumn; and (3) the enrichment of suspended matter in iron and manganese due to the oxidation-precipitation of reduced iron and manganese. The role of the coastal sediments investigated as an important site of organic matter mineralization is stressed by the dissolved oxygen profiles indicating a transition from 100 < 1% saturation within the surface 3 mm of sediment. This steep gradient sustains a rate of oxygen inflow from the watercolumn balancing consumption. Depletion of oxygen results in the mobilization of sedimentary iron and manganese. The source strength of dissolved iron and manganese from the coastal sediments is shown to be compatible with the observed magnitude of iron and manganese enrichments in suspended matter, stressing the role of the sediments as main source. The enrichment data for suspended matter also suggest that sediments remain a source for iron and manganese enrichments in suspended matter as successing the role of the sediments is period till February. Between February and the onset of the phytoplankton bloom in April-May, oxic conditions appear to be restored in surface sediments for these elements in suspended matter

PORE WATER CHEMISTRY OF RARE EARTH ELEMENTS IN BUZZARDS BAY SEDIMENTS. Woods Hole Oceanographic Institution, MA. For primary bibliographic entry see Field 2J. W90,07008

ORGANIC GEOCHEMISTRY AND BRINE COMPOSITION IN GREAT SALT, MONO, AND WALKER LAKES.
Johns Hopkins Univ., Baltimore, MD. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2J. W90-07009

CHEMISTRY OF STREAMS DRAINING GRASSLAND AND FOREST CATCHMENTS AT PLYNLIMON, MID-WALES. Institute of Terrestrial Ecology, Bangor (Wales).

Institute of Terrestrial Ecology, Bangor (waics). Bangor Research Station, B. Reynolds, M. Hornung, and S. Hughes. Hydrological Sciences Journal HSJODN, Vol. 34, No. 6, p 667-686, December 1989. 5 fig. 10 tab, 40

Descriptors: "Acidification, "Forest watersheds, "Grasslands, "Land use, "Wales, "Water analysis, "Water chemistry, Anions, Catchment areas, Cations, Drainage area, Forest hydrology, Ion transport, Mineralization, Soil water, Solutes, Streams, Throughfall,

The chemistry of streamwater, bulk precipitation, throughfall and soil waters was studied for three years in two plantation forest and two moorland catchments in mid-Wales. Na and Cl are the major ions in streamwater reflecting the maritime influence on atmospheric inputs. In all streams, baseflow is characterized by high pH waters enriched in Ca, Mg, Si and HCO3. Differences in baseflow chemistry between streams reflect the varying extent of calcite and base metal sulfide mineralization within the catchments. Except for K, mean stream solute concentrations are higher in the unmineralized and mineralized forest catchments compared with their respective grassland counterparts. In the forest streams, storm flow concentrations of H(+) are approximately 1.5 times and Al four times higher than in the moorland streams. Annual catchment losses of Na, Cl, SO4, NO3, Al and Si are greatest in the forest streams. In other grassland and forest systems, variations in stream hemistry is explained by mixing waters from different parts of the catchment, although NO3 concentrations may additionally be controlled by N transformations occurring between forest and moorland catchments are related to greater atmospheric scavenging by the trees and changes in catchment hydrology consequent of aforestation. Mineral veins within the catchment bedrock can significantly modify the stream chemical response to aforestation. (Author's abstract)

REMOVAL OF SOME HEAVY METALS BY MORDENITE.

Delaware Univ., Newark. Dept. of Civil Engineer-

ing.
C. P. Huang, and O. J. Hao.
Environmental Technology Letters ETLEDB,
Vol. 10, No. 10, p 863-874, October 1989. 8 fig, 2
tab, 22 ref. NSF Grant CE 8104728.

Descriptors: *Adsorption, *Heavy metals, *Mordenite, *Path of pollutants, *Wastewater treatment, *Water pollution treatment, *Water treatment, Ion exchange, Silicates, Soil contamination, Water chemistry, Water pollution.

One of the processes which affect the metal concentration in an environment is its adsorption onto solid phases. Various types of adsorbents, including aluminosilicates in the aquatic or soil environment, can be recognized. Metal removal capability by an aluminosilicate, mordenite, was investigated. Type of metal, pH, and surface loading are the most important factors controlling metal removal by mordenite. The extent of removal follows the order of Pb > Cd > Zn. Ion exchange is the most

important mechanism for metal removal by mordenite at pH < 7. In the presence of ligands, metal removal capability is affected by the extent of metal complexation. Hence, there is no effect on metal removal in the presence of equal molar concentration of weak ligands such as glycine. Strong complex-formers such as ethylenediaminetetraacetate significantly impedes metal removal by mordenite. (Author's abstract) W90-07052.

FIELD AND LABORATORY STUDIES ON NILE PHYTOPLANKTON IN EGYPT: III. SOME PHYSICAL AND CHEMICAL CHARACTERISTICS OF ASWAN HIGH DAM LAKE (LAKE NASSER).

Assiut Univ. (Egypt). Dept. of Botany. For primary bibliographic entry see Field 2H. W90-07101

SIMULATION OF THE LONG-TERM SOIL RESPONSE TO ACID DEPOSITION IN VARIOUS BUFFER RANGES.

Winard Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands). For primary bibliographic entry see Field 5B. W90-07130

INFLUENCE OF BEDROCK GEOCHEMISTRY ON THE HEAVY METAL CONTENT OF STREAM WATER, MARINE WATER, MARINE SEDIMENTS AND ORGANISMS IN ST. JOHN, USVI.

Center for Energy and Environment Research, San Juan, PR.

C. R. Ramos-Perez, C. Gines-Sanchez, and W. H. McDowell.

Caribbean Journal of Science CRJSA4, Vol. 25, No. 3/4, p 218-227, December 1989. 2 fig. 4 tab, 26 ref.

Descriptors: *Geochemistry, *Heavy metals, *Marine environment, *Path of pollutants, *Sediment contamination, *Water chemistry, *Water pollution sources, Bioaccumulation, Chromum, Copper, Fish Bay, Iron, Magnesium, Manganese, Nickel, Tissue analysis, Virgin Islands (US), Zinc.

Three metal-rich geochemical anomalies have been identified in St. John, Virgin Islands (US). In order to determine whether these anomalies contribute significant amounts of heavy metals to near shore marine ecosystems, concentrations of Fe, Mg, Mn, Cu, Cr, Ni and Zn were measured in stream w sea water, marine sediments and marine organisms sea water, marine sectiments and marine organisms from five watersheds affected by the anomalies. Concentrations in all sample types followed a similar pattern: Mg > Fe > Mn > Cu > Cr > Ni > Zn. Concentrations in stream water and sea water were typical of unpolluted areas, and only iron exceeded U.S. EPA (Environmental Protection Agency) standards in both sample types. Manga-nese also exceeded U.S. EPA standards for seawater. The estimated export of iron and magnesi-um exceeded 100 g/ha/yr; export of the other metals rarely exceeded this value. There was great variability in the estimated annual export rate depending primarily on the magnitude and frequency of rain events. Metal concentrations in marine sedior rain events. Wetai Concentrations in marine seuments also were typical of unpolluted sites. Intensive sampling in Fish Bay demonstrated that manganese, nickel and iron were horizontally zonated with respect to the discharge point of Fish Bay Gut. There was great variability in the concentration of metals in the tissues of various marine organisms. Although samples from several water-sheds were analyzed, no conclusions can be made concerning the relative impact of the geochemical anomalies in these watersheds due to the limited number of samples taken. However, marine water and sediments from Fish Bay had higher concentrations of some metals than the other bays, suggesting that the Fish Bay geochemical anomaly may contribute significant quantities of metals to the nearby marine environment. (Author's ab-W90-07238

Field 2—WATER CYCLE

Group 2K—Chemical Processes

REMOVING RADIUM BY ADDING PRE-FORMED HYDROUS MANGANESE OXIDES, Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 5F. W90-07329

EXTRACTING HEAVY METALS FROM MU-NICIPAL AND INDUSTRIAL SLUDGES. National Taiwan Univ., Taipei. Inst. of Environmental Engicering. For primary bibliographic entry see Field 5D. W90-07345.

SPECIATION OF ALUMINIUM IN SURFACE WATER.

Ghent Rijksuniversiteit (Belgium). Inst. voor Nukleaire Wetenschappen. E. Courtijn, V. Vandecasteele, and R. Dams. Science of the Total Environment STENDL, Vol. 90, p 191-202, January 1990. 7 fig, 2 tab, 14 ref.

Descriptors: *Acid rain effects, *Aluminum, *Chemical speciation, *Ions, *Path of pollutants, *Water chemistry, *Water pollution sources, Chemical studies, Fluorides, Humic acids, Hydrogen ion concentration, Neutron activation analysis, Spectroscopy, Surface water, Toxicity.

A Chelex-100 ion exchange column was used for the separation of different dissolved aluminum species occurring in acidified waters in the Belgian Campine. The samples were filtered through Whatman 41 and 0.4 micron Nuclepore filters and the particulate aluminum was determined by instrumental neutron activation analysis. The filtrates were submitted to ion exchange in order to separate aluminum combined with humic acid, fluoride-complexed aluminum, and free or hydrolyzed aluminum. The concentrations in the different fractions were determined by inductively coupled plasma atomic emission spectrometry. Humic acid, originating from the soil, is the main component of bogs. Due to its high complexing capacity with cations, it may decrease aluminum toxicity. The more toxic forms, Al(OH)(2+) and Al(OH)2(+), still represent an important fraction of the total aluminum between pH 4 and 6, especially when the humic acid content is low. In general, the concentration of fluoride in the bogs, originating from atmospheric deposition, is too low to complex a major fraction of aluminum. (Author's abstract)

COLLOID MOBILIZATION IN TWO ATLANTIC COASTAL PLAIN AQUIFERS: FIELD STUDIES,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. For primary bibliographic entry see Field 5B. W90-07359

STRUCTURAL STUDIES OF MARINE AND RIVERINE HUMIC MATTER BY CHEMICAL DEGRADATION.

Hamburg Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum. For primary bibliographic entry see Field 7B. W90-07369

PY-GC-MS ANALYSIS OF ORGANIC MATTER IN SUSPENDED MATERIAL AND DEPOSITS OF THE SUB-MARINE DELTA OF THE RHONE RIVER (FRANCE).

Instituto Quimico de Sarria, Barcelona (Spain). Dept. Quimica Analitica. For primary bibliographic entry see Field 7B.

MAJOR AND TRACE ELEMENTS IN STANDARD AND REFERENCE SAMPLES OF AQUATIC HUMIC SUBSTANCES DETERMINED BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS (INAA).
National Inst. of Public Health, Oslo (Norway). For primary bibliographic entry see Field 7B.

W90-07371

SPECTROSCOPIC AND COMPOSITIONAL COMPARATIVE CHARACTERIZATION OF LH.S.S. REFERENCE AND STANDARD FULVIC AND HUMIC ACIDS OF VARIOUS ORIGIN.

Bari Univ. (Italy). Ist. di Chimica Agraria. For primary bibliographic entry see Field 7B. W90-07372

NATURALLY PRODUCED ADSORBABLE OR-GANIC HALOGENS (AOX) IN HUMIC SUB-STANCES FROM SOIL AND WATER. Linkoeping Univ. (Sweden). Dept. of Water and Environmental Research. G. Asplund. A. Grimvall, and C. Petterson.

G. Asplund, A. Grimvall, and C. Petterson. Science of the Total Environment STENDL, Vol. 81/82, p 239-248, June 1989. 3 fig, 4 tab, 18 ref.

Descriptors: *Groundwater pollution, *Halogenated compounds, *Humic substances, *Organic acids, *Soil water, *Water pollution sources, Adsorption, Bogs, Fulvic acids, Organic carbon, Organic matter, Peat, Soil contamination.

The amount of adsorbable organic halogens (AOX) in surface water, groundwater, soil and a raised bog was measured by a method which absorbs the humic substances onto activated carbon, and detects halogens through combustion and microcoulometric titration with silver ions. Areas far from industrial activities contained measurable amounts of AOX. In surface water, the ratio between AOX and total organic carbon (TOC) varied between 730 and total organic carbon (TOC) waried between 730 and total organic carbon (TOC) waried between 730 and \$600 micrograms/gm. In soil, the AOX content ranged from 210 to 1400 micrograms AOX/gm organic matter. The fact that organohalogens (230-370 micrograms/gm) could be detected in fulvic acids isolated from old groundwaters (1300, 4600 and 5200 yrs) indicated a large natural production of organohalogens. This hypothesis was further strengthened by mass balance calculations for a raised bog in Sweden. The pool of AOX in this bog is at least 300 times larger than the present annual deposition. The total pool of AOX in the pool of AOX in this too gis at least 300 times larger than the present annual deposition. The total pool of AOX in peat in Sweden was estimated to be at least 30,000 metric tons. Artifacts in the analysis such as trapped inorganic halides in soil particles should be taken into consideration when determining the amount of AOX. (Geiger-PTT)

VOLATILE COMPOUNDS ASSOCIATED WITH AQUATIC HUMIC SUBSTANCES. National Inst. of Public Health, Oslo (Norway). For primary bibliographic entry see Field 2H. w90-07379

PROPERTIES OF FULVIC ACIDS FROM DEEP GROUNDWATERS. Linkoeping Univ. (Sweden). Dept. of Water and Environmental Research.

For primary bibliographic entry see Field 2F. W90-07380

FACTORS AFFECTING THE VARIATION IN THE AVERAGE MOLECULAR WEIGHT OF DISSOLVED ORGANIC CARBON IN FRESHWATERS.

Toronto Univ. (Ontario). Dept. of Zoology. H. E. Evans, R. D. Evans, and S. M. Lingard. Science of the Total Environment STENDL, Vol. 81/82, p 297-306, June 1989. 4 fig, 1 tab, 22 ref.

Descriptors: *Dissolved organic carbon, *Lakes, *Limnology, *Molecular weight, *Water chemistry, Catchment areas, Color, Humic substances, Hydrogen ion concentration, Lake morphology.

The molecular size distribution of concentrated filtered (< 0.45 microns) lake water samples, col-lected from 20 lakes in Ontario, Canada, was measured using size exclusion chromatography (Sephadex G-25, fractionation range 100-5900 dalton). Average molecular weights ranged from 1225 to 2170 and a strong positive correlation was observed between average molecular weight and disserved between average molecular weight and disserved between average molecular weight and dis-

solved organic carbon concentration, of which humic substances were a major component. Additional factors which may affect the variation in the average molecular weights among the study lakes were also examined and included catchment area, lake area, ratio of catchment area to lake area, percentage of peat in the catchment, and pH. Of these, the ratio of catchment area to lake area appeared to be the most important and explained 25.9% of the variance in average molecular weights. (Author's abstract)

COMPARISON OF MOLECULAR WEIGHT DISTRIBUTION AND ACID/BASE PROPERTIES BETWEEN THE IHSS NORDIC FULVIC ACID AND WHOLE WATER HUMIC SUBSTANCES.

National Inst. of Public Health, Oslo (Norway). D. Hongve, G. Akesson, and G. Becher. Science of the Total Environment STENDL, Vol. 81/82, p 307-314, June 1989. 2 fig. 11 ref.

Descriptors: *Fulvic acids, *Humic substances, *Laboratory methods, *Sampling, *Water analysis, *Water chemistry, Gas chromatography, Molecular weight, Organic matter, Separation techniques.

Some properties of the Nordic fulvic acid reference material were compared with untreated water from the same source, an evaporated and freezedried whole water sample, and the International fulvic acid sample. The samples were characterized according to molecular weight distribution by high-performance size exclusion chromatography. A method was developed for continuous recording of dissolved organic carbon in the eluate from the chromatographic column. The content of titratable groups was measured with acid/base titration. Results were plotted as curves for buffer intensity as functions of pH. This method made it possible to demonstrate the impact of various compounds on the total buffer capacity. Increased molecular weight was found in the isolated fulvic acid which made it elute from the column faster than the reference materials. The acid/base properties of total dissolved organic substances were in good agreement with the isolated fulvic acid. (Geiger-PTT)

ANALYSIS OF HUMIC AND LIGNIN COM-POUNDS IN THE NORTHERN BALTIC SEA. National Board of Waters, Helsinki (Finland). For primary bibliographic entry see Field 7B. W90-07383

HUMIC SUBSTANCES IN HOLOCENE SEDI-MENTS OF THE SKAGERRAK (NE NORTH SEA) AND THE ELBE RIVER,

Hamburg Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum. G. Fengler, E. T. K. Haupt, and G. Liebezeit. Science of the Total Environment STENDL, Vol. 81/82, p 335-342, June 1989. 6 fig, 1 tab, 9 ref. Bundesministerium fuer Forschung und Technologie Contract MFU 08534.

Descriptors: *Fluvial sediments, *Humic acids, *Marine sediments, *North Sea, *Sediment analysis, *Sediment chemistry, Amino acids, Carbohydrates, Chemical properties, Humic substances, Molecular structure

Humic acids, isolated from Skagerrak (VA 28/12) and Elbe sediments, have been characterized by elementary, amino acid and carbohydrate analysis as well as infrared, nuclear magnetic resonance (NMR) and CPMAS-NMR spectroscopy. Samples from core VA 28/12 were suboxic whereas Elbe sediments were strongly reducing. Both were comparable in grain size composition as examined by visual inspection. Elementary analysis gave an average composition for Skag humic acids of C14.1NO5.8H17-9 and C14.0NO4.8H14.2 for Elbe humic acids plotted close to kerogen type III (terrestrial). Skag humic acids occupied a position intermediate between types II (marine) and III.

Estuaries—Group 2L

Clay fraction humic acids from Wadden Sea sediments plotted closer to type II material. This suggests some terrestrial contribution in Skag humic acids. E4/E6 ratios were 5.2 (Elbe) and 5.1 (Skag). acids. E4/E6 ratios were 5.2 (Elbe) and 5.1 (Skag). IR spectra showed no significant differences either in position or intensity of absorption maxima except for the carbonyl band at 1725/cm. C13-High resolution-NMR indicated a somewhat higher content of aliphatic (0-50 ppm) and carbohydrate moieties (50-110 ppm) in Skag humic acids although the spectra were difficult to compare due to the high noise level. Aromatic carbon content (110-160 ppm) appeared to be slightly higher in Elbe humic acids. A comparison with C13-CPMAS spectra of diatoms and lignin showed that lignin was not prominent in Elbe humic acids. Compared to the diatom spectrum, both Elbe humic acids, and Skag humic acids had lower carbohydrate contents. Amino acids in Elbe humic acids acounted for significantly higher proportions. caronydrate contents. Amino acids in Eibe humic acids accounted for significantly higher propor-tions of both carbon and nitrogen than in Skag humic acids. Amino acid composition, however, was similar for both isolates with aspartic and glutamic acids, alanine and glycine being the domi-nant compounds. Skag humic acids were enriched in aspartic acid, glycine and lysine whereas a in aspartic acid, glycine and lysine whereas a slightly higher leucine content was found in Elbe humic acids. Significantly higher mannose, fructose and fucose contents were found in Skag humic acids whereas galactose and arabinose were enriched in Elbe humic acids. (Geiger-PTT) W90-07384

HUMIC-LIKE SUBSTANCES FROM LAND-FILL LEACHATES: CHARACTERIZATION AND COMPARISON WITH TERRESTRIAL AND AQUATIC HUMIC SUBSTANCES, Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.

For primary bibliographic entry see Field 5B. W90-07385

SOURCES AND CHARACTERISTICS OF FULVIC AND HUMIC ACIDS FROM A SALT MARSH ESTUARY

MARSH ESTUARY. Georgia Univ, Sapelo Island. Marine Inst. J. J. Alberts, and Z. Filip. Science of the Total Environment STENDL, Vol. 81/82, p 353-361, June 1989. 2 fig, 2 tab, 3 ref.

Descriptors: *Estuaries, *Fulvic acids, *Humic acids, *Humic substances, *Salt marshes, Amino acids, Carbohydrates, Chemical properties, Marine sediments, Organic acids, Organic carbon, Sedi-ment analysis, Sediment chemistry, Spartina.

Fulvic and humic acids were isolated from living and dead Spartina alterniflora and the marsh sediments of a Georgia salt marsh estuary. Elemental composition, Cl3-nuclear magnetic resonance, Fourier transform infrared spectra, carbohydrate and amino acid analyses were performed on these and amino acid analyses were performed on these compounds and indicate that these fulvic acids and humic acids are very similar regardless of source material. Furthermore, both groups of compounds generally resemble marine humic matter, although specific differences can be identified. Calculations indicate that 28.6% of the fullvic acid carbon and 14.8% of the humic acid carbon can be accounted for as sugars and amino acids. (Author's abstract) W90-07386

HUMIC SUBSTANCES IN A CATENA OF ESTUARINE SOILS: DISTRIBUTION OF ORGANIC NITROGEN AND CARBON.

Instituto de Investigaciones Agrobiologicas de Galicia, Santiago (Spain).

S. J. Gonzalez Prieto, M. A. Lista, M. Carballas,

and T. Carballas.

Science of the Total Environment STENDL, Vol. 81/82, p 363-372, June 1989. 6 fig, 3 tab, 13 ref.

Descriptors: *Estuaries, *Humic substances, *Marine sediments, *Organic matter, Decomposing organic matter, Nitrogen, Nitrogen compounds, Organic acids, Organic carbon.

The organic fractions of a catena comprising two eutric fluvisols, one in the intertidal zone of an estuary and the other on its bank, and a distric

cambisol that is not affected by seawater are described. The humus of the fluvisols has features inherited from the terrestrial humus together with others acquired during its evolution in the marine environment. All the samples had little unhumified organic matter, a fair amount of humin and a major organic matter, a tair amount of humin and a major fraction that is soluble in alkalis. Exposure to sea-water changes the kind of organo-metallic com-plexes present and alters the relative solubility of humic and fulvic acids in alkaline reagents, thereby modifying the degree of polymerization of the humus. The distribution of organic nitrogen also changes with exposure to require amounts. changes with exposure to seawater: amnonium content gradually rises, amide content remains practically constant and amino acids fall gradually, while hexosamines, hydrolysable unknown nitrogen and hydrolysable organic nitrogen all decrease sharply. (Author's abstract)

W90-07387

INFLUENCE OF VENICE LAGOON MACRO-FAUNA ON NUTRIENT EXCHANGE AT THE SEDIMENT-WATER INTERFACE.

Venice Univ. (Italy). Dept. of Environmental Sci-

For primary bibliographic entry see Field 2L.

DENITRIFICATION AND OXYGEN RESPIRA-TION IN BIOFILMS STUDIED WITH A MI-CROSENSOR FOR NITROUS OXIDE AND OXYGEN Aarhus Univ. (Denmark). Inst. of Ecology and

Genetics. For primary bibliographic entry see Field 2H. W90-07411

CHEMICAL CHARACTERISTICS OF A MEDI-TERRANEAN RIVER AS INFLUENCED BY LAND USES IN THE WATERSHED, Barcelona Univ. (Spain). Dept. de Ecologia. For primary bibliographic entry see Field 5B. W90-07415

SEASONAL VARIATIONS OF THE DEUTERI-UM CONTENT IN THE PARANA AND LIMAY

RIVERS.
Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Quimica Analitica. E. A. Gautier, R. A. Lukaszew, and R. E. Servant. Water Research WATRAG, Vol. 24, No. 2, p 191-194, February 1990. 3 fig, 14 ref.

Descriptors: *Argentina, *Baseline studies, *Deuterium, *Hydrogen, *Mass spectrometry, *Water quality, Correlation analysis, Flow, Limay River, Parana River, Seasonal variation.

An analysis of the possible sources of small deuteri-um/hydrogen ratio (D/H) variations in waters is manyarogen ratio (D/H) variations in Maters is made and applied to the Parana and Limay rivers in Argentina. These two rivers were studied be-cause their waters will feed an experimental and an industrial plant for the production of heavy water, industrial plant for the production of heavy water, respectively. The isotopic analysis was made by mass spectrometry. The average D/H concentration found for the Parana and Limay rivers was 150.8 and 144.4 ppma, respectively. Seasonal D/H variations of about 1% were found for the Parana river and could be correlated with flow fluctua-tions over the year. The Limay river did not show the same variations, the deuterium content remain-ing constant over the year, within the experimental error. (Author's abstract) W90-07420

COMPARATIVE STUDY OF PRECIPITATION CHEMISTRY AT INLAND, COASTAL AND ISLAND SITES IN THE BOTHNIAN BAY

Stockholm Univ. (Sweden). Meteorologiska Insti-For primary bibliographic entry see Field 5B. W90-07478

DETERMINATION OF HYDROGEN CARBONATE IN RAINWATER,

Warren Spring Lab., Stevenage (England). For primary bibliographic entry see Field 2B. W90-07490

2L. Estuaries

ECOLOGICAL EFFECTS OF COOLING WATER DISCHARGE ON HYDROLITTORAL EPILITHIC DIATOM COMMUNITIES IN THE NORTHERN BALTIC SEA.
Uppsala Univ. (Sweden). Inst. of Ecological Botany.

For primary bibliographic entry see Field 5C. W90-06579

MECHANISMS AND ECOLOGICAL CONSE-QUENCES OF ANNUAL DESTRATIFICATION QUENCES OF ANNUAL DESTRATIFICATION
IN A STRATIFIED EUTROPHIC ENVIRONMENT (MECANISMES ET INCIDENCES ECOLOGIQUES DE L'HOMOGENEISATION ANNUELLE DE DENSITE DANS UN MILIEU EUTROPHE STRATIFIE).

Centre de Recherches Oceanographiques, Abidjan

Centre de Rechetches Cocanaga, p. 100 (Ivory Coast).
D. Guiral, R. Arfi, and J. P. Torreton.
Hydrobiologia HYDRB8, Vol. 183, No. 3, p 195-210, 1989. 10 fig, 33 ref. English summary.

Descriptors: *Bays, *Density stratification, *Destratification, *Ivory Coast, Ecological effects, Salinity, Seasonal variation, Tidal currents, Water chemistry, Water sampling.

Two sets of data were collected in the Bietri bay (Ebrie lagoon, Ivory Coast). The first one concerns a program with a low frequency sampling (October 1985-March 1986), during which hydroclimatic conditions necessary to the suppression of the density gradient (increasing surface salinity, cooling of surface waters in relation with a coastal upwelling) were defined. The second one refers to a high frequency program (January-February 1987), in the same area, in order to describe the mechanisms and the ecological consequences of mechanisms and the ecological consequences of the destratification. When hydroclimatic condi-tions are favorable, destratification occurs during a tions are tavorable, destratineation occurs during a spring tide period, corresponding to an exceptional low waters, induced by a higher tidal current velocity in the bay, evidenced by a low Richard-son number. That destratification allows an homogenization of vertical profiles of nutrient con-centrations, but leads mainly to the disappearance of 90% of N-NH4 and 60% of the P-PO4 loads. A modification of the chemical environment in the hypolimnion during its re-oxygenation is proposed to explain this sudden and transitory disappearance. On the contrary, the vertical distribution of biomass seems to be little affected by the gradient suppression, the bottom topography preventing from important convective movements. Thus, the biological consequences of the destratification in this eutrophic estuarine area are not as important as the hydrodynamical and hydrochemical modifications observed during this phenomenon. (Author's abstract) W90-06593

TRACE METALS IN BIVALVES AND SEDI-MENTS FROM TOLO HARBOUR, HONG KONG

Chinese Univ. of Hong Kong, Shatin. Dept. of For primary bibliographic entry see Field 5B. W90-06606

HEAVY METAL DETECTION IN THE SEDI-MENT-WATER COMPONENTS OF THE SADO ESTUARY BY MULTIELEMENTAL ANALY-

Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal). For primary bibliographic entry see Field 5A. W90-06620

STEADY-STATE ANALYSIS OF THE 'MICRO-BIAL LOOP' IN STRATIFIED SYSTEMS. Marine Biological Association of the United King-

Field 2-WATER CYCLE

Group 2L—Estuaries

dom, Plymouth (England). A. H. Taylor, and I. Joint. Marine Ecology Progress Series MESEDT, Vol. 59, No. 1/2, p 1-17, January 1990. 9 fig, 2 tab, 47

Descriptors: *Bacterioplankton, *Food chains, *Mathematical models, *Microorganisms, *Phytoplankton, *Population dynamics, Dissolved organic carbon, Mixing, Nitrates, Zooplankton.

Steady state solutions are presented for a simple model of the surface mixed layer, which contains the components of the 'microbial loop', namely phytoplankton, picophytoplankton, bacterioplankton, microzooplankton, dissolved organic carbon, cartinus, nitrate, and ammonia. This system is asdetrius, hitrate, and ammonia. Inis system is as-sumed to be in equilibrium with the larger grazers present at any time, which are represented as an external mortality function. The models also allows for dissolved organic nitrogen consumption by bacteria, and self-grazing and mixotrophy of the microzooplankton. The model steady states are always stable. The solution shows a number of aways state. The solution shows a number of general properties, for example, biomass of each individual component depends only on total nitrogen concentration below the mixed layer, not whether the nitrate is in the form of nitrate or ammonia. Standing stocks and production rates from the model are compared with summer observations from the Celtic Sea and Porcupine Sea Bight. The agreement is good and suggests that the system is not often far from equilibrium. A sensitivity analysis of the model is included. The effect of varying the mixing across the pycnocline is investigated; more intense mixing results in the large phytoplankton population increasing at the exphytoplankton population increasing at the ex-pense of picophytoplankton, microzooplankton and DOC. The change from phytoplankton to picophytoplankton dominance at low mixing occurs even though the same physiological param-eters are used for both size fractions. The F-ratio occurs even though the same physiological parami-eters are used for both size fractions. The F-ratio falls abruptly at low mixing rates. Estimates of microbial food web efficiency made with this model show that bacteria are not important, a result confirmed by excluding bacteria from the system. The model therefore does not support the 'microbial loop' hypothesis. (Author's abstract) W90-06631

MEIOFAUNAL RESPONSES TO SEDIMENTA-TION FROM AN ALASKAN SPRING BLOOM: II. HARPATICOID POPULATION DYNAMICS. Louisiana State Univ., Baton Rouge, Dept. of Zoology and Physiology.

J. W. Fleeger, and T. C. Shirley.

Marine Ecology Progress Series MESEDT, Vol. 59, No. 3, p 239-247, January 1990. 7 fig, 38 ref. NOAA Contract No. NA-85-ABH-022.

Descriptors: *Copepods, *Marine animals, *Population dynamics, *Seasonal variation, *Sedimentation, Food chains, Population density, Reproductive cycle. Sex ratio. Species composition

Metazoan meiofaunal major taxon seasonal variation and density maxima have been shown to be tion and density maxima have been shown to be unrelated to spring phytoplankton sedimentation over a four year period in Auke Bay, Alaska. To determine how individual species responded to sedimentation, meiobenthic copepods were analyzed separately. The harpaticoid copepod assemblage was diverse: thirty-five species, of which 16 were common and abundant each field season and throughout the bay. Three species, Tachidiella cf. minuta, Danielssenia reducta Gee and Pseudameira n. dominated collections, comprising about 60%. minuta, Dameissema reducts over an executamenta ap., dominated collections, comprising about 60% of all individuals. Reproductive cycles in some species appeared to be related to the April-May sedimentation event. Age-structured data indicate marked changes coincident with sedimentation for marked changes coincident with sedimentation for tow of the three predominant species. In the over-wintering species D. reducta and T. cf. minuta, the proportion of copepodites increased in April and May and striking increases in the proportions of males followed in May and June annually. This pattern suggests that a cohort is produced in con-inaction with period exclinentation. Pseudomain pattern suggests that a conort is produced in con-junction with spring sedimentation. Pseudameira sp. produced early, before spring sedimentation. Most significantly however, seasonality in popula-tion density was not obvious, and although abun-dances differed among years, density maxima did

not co-vary with sedimentation intensity. This suggests that harpaticoid density maxima are not tightly linked with phytodetritus and that other factors regulate abundance. (Author's abstract) W90-06632

SEASONAL PATTERNS OF BACTERIAL PRODUCTION AND BIOMASS IN INTERTIDAL SEDIMENTS OF THE WESTERN DUTCH WADDEN SEA.

WADDEN SEA. Nederlands Inst. voor Onderzoek der Zee, Texel. F. C. van Duyl, and A. J. Kop. Marine Ecology Progress Series MESEDT, Vol. 59, No. 3, p 249-261, January 1990. 7 fig. 6 tab, 68

Descriptors: *Bacterial physiology, *Bacterial production, *Biomass, *Estuarine sediments, *Season-al variation, *Wadden Sea, Isotopic tracers, Littoral environment, Population dynamics, Sedimenta-

Tritiated-methyl thymidine incorporation, bacterial abundance and biomass were measured over one year on intertidal flats in the western Dutch Wadden Sea. Thymidine incorporation and biomass carbon production peaked in March and in mid-late summer with thymidine incorporation rates ranging from 15 to 15,300 nm/L wet sediment/day in the top 3 mm of sediment (0.4 to 518 mg carbon/L wet sediment/day). Bacterial production was site-specific. The higher bacterial production at one site could be related to higher organic carbon sedimentation. At most sites bacterial production covaried with particulate organic Tritiated-methyl thymidine incorporation, bacterial rial production covaried with particulate organic carbon content and its decomposable fraction in the sediment, suggesting nutrient stress. Covariation of production with bacterial abundance and biomass was not found. The latter variables showed a distinct seasonality with lowest values in spring/summer and highest values in autumn. Regulation of bacterial density appeared to be strongly density-dependent. (Author's abstract) W90-06633

METABOLIC ACTIVITY OF SIZE-FRACTION-ATED MICROBIAL PLANKTON IN ESTUA-RINE, NEARSHORE, AND CONTINENTAL SHELF WATERS OF GEORGIA.

SHELF WATERS OF GEORGIA.
Georgia Univ., Athens. Inst. of Ecology.
P. C. Griffith, D. J. Douglas, and S. C. Wainright.
Marine Ecology Progress Series MESEDT, Vol.
59, No. 3, p. 263-270, January 1990. 5 fig, 4 tab, 32
ref. DOE Grant DE-FG09-86ER60451.

Descriptors: *Bacterial physiology, *Coastal waters, *Continental shelf, *Estuaries, *Georgia, *Microorganisms, *Separation techniques, Ecosystems, Growth efficiency, Plankton, Respiration.

Estimates of bacterial production and activity, and of planktonic community respiration, were made at a series of stations starting in an estuary, passing through the coastal front, and across the continenthrough the constant from, an across the commen-tal shelf to a distance of 120 kilometers offshore in the Georgia Bight. Measurements were made on unfiltered and on 1.0 micrometer (pore-size) fil-tered water samples to examine the small free-living bacterial size fraction relative to the larger plankton. In waters landward of the coastal front, about 50 to 80% of bacterial and community activity was associated with the larger size fraction, indicating the importance of larger and particle-associated heterotrophs in the nearshore, highly turbid water. Seaward of the front, 80 to 90% of activity was in the < 1.0 micrometer fraction.

Thus, the < 1.0 micrometer fraction is responsible for most of the respiration in shelf-waters.

Bacterial production and activity decreased markedly with distance from shore; community respira-tion also decreased across the shelf, but not as much as the bacterial production decreased. Bacterial growth efficiency was low in estuarine waters (11%), and decreased in nearshore (6%) and shelf (2%) waters. (Author's abstract) W90-06634

HYDROCARBON WEATHERING AND BIO-DEGRADATION IN A TROPICAL ESTUARINE

Museume National d'Histoire Naturelle, Paris (France). Lab. de Cryptogamie. For primary bibliographic entry see Field 5B.

EXPECTED EFFECTS OF THE USE OF THE OOSTERSCHELDE STORM SURGE BARRIER ON THE SURVIVAL OF THE INTERTIDAL FAUNA: PART 1. THE EFFECTS OF PROLONGED EMERSION.

Delta Inst. for Hydrobiological Research, Yerseke For primary bibliographic entry see Field 6G. W90-06639

EXPECTED EFFECTS OF THE USE OF THE OOSTERSCHELDE STORM SURGE BARRIER ON THE SURVIVAL OF THE INTERTIDAL FAUNA: PART 2. THE EFFECTS OF PROTRACTED TIDAL CYCLES.

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands). For primary bibliographic entry see Field 6G. W90-06640

DISTRIBUTION OF TRACE METALS IN SOME REPRESENTATIVE FAUNA OF THE SOUTHERN BALTIC. Akademia Medyczna, Gdansk (Poland). Dept. of

Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W90-06641

CHROMIUM FLUXES THROUGH MEX BAY INSHORE WATERS.

Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 5B. W90-06642

PESTICIDES AND PCBS IN SOUTH CAROLI-NA ESTUARIES. Fluor Daniel, Greenville, SC.

For primary bibliographic entry see Field 5B. W90-06648

PRIMARY PRODUCTION IN THE COLUMBIA RIVER ESTUARY, I: SPATIAL AND TEMPORAL VARIABILITY OF PROPERTIES, Centro de Investigacion Científica y de Educacion

Superior de Ensenada (Mexico).

J. R. Lara-Lara, B. E. Frey, and L. F. Small.

Pacific Science PASCAP, Vol. 44, No. 1, p 17-37,

January 1990. 13 fig. 5 tab, 58 ref.

Descriptors: *Chlorophyll, *Columbia River Estu-Descriptors: "Columbia Miver Esti-ary, "Estuarine environment, "Light penetration, "Nutrient concentrations, "Particulate matter, "Or-ganic carbon, "Plant pigments, "Primary produc-tivity, "Temporal variation, "Turbidity, "Water temperature, Light, Mf St Helens, Nitrogen com-pounds, Phytoplankton, Seasonal variation.

Estuarine systems are perhaps the most variable of aquatic ecosystems, exhibiting frequent physicochemical fluctuations and varying over tidal, diel and seasonal cycles. Light, major nutrients, water temperature, turbidity, and its inorganic and organic fractions, chlorophyll, phaeophytin, DCMU (3,4-dichlorophenyl)-1,1 dimethyl urea)-enhancic carbon (POC), particulate organic carbon (POC), particulate organic nitrogen (PON), and primary production were measured from April 1980 through April 1981 in a 65 kilometer stretch of Columbia River estuary. Daily solar input, light attenuation in the water, and chlorophyll concentration accounted for 75% of the variability of daily primary production in the main estuarine axis and 85% in the shallows. The rapid appearance of a turbidity load created by the Mt. Saint Helens volcanic eruption in May 1980 and the subsequent clearing of the water as the load moved out of the estuary became a natural experiment to show that estuary became a natural experiment to show that light availability was indeed the limiting factor to phytoplankton production in the estuary. Spatial variability in the chlorophyll concentration was caused mainly by large summer reductions at the

WATER CYCLE—Field 2

Estuaries—Group 2L

location where freshwater cells were lysed on contact with low-salinity intrusions. Mean values for properties in the main axis generally were not significantly different from those in the shallows, suggesting that the main axis and shallows experience similar, rapid flushing times. Total primary production for the estuary was almost 30,000 metric tons of carbon per year, but areal production was only 100 grams of carbon per square meter per year, which puts the Columbia system at the low end of North American estuaries. (See also W90-06650) (Author's abstract) location where freshwater cells were lysed on con-

PRIMARY PRODUCTION IN THE COLUMBIA PRIMARY PRODUCTION IN THE COLUMBIA RIVER ESTUARY. II: GRAZING LOSSES, TRANSPORT, AND A PHYTOPLANKTON CARBON BUDGET. Centro de Investigacion Científica y de Educacion Superior de Ensenada (Mexico).

J. R. Lara-Lara, B. E. Frey, and L. F. Small. Pacific Science PASCAP, Vol. 44, No. 1, p 38-50, January 1990. 4 fig, 6 tab, 53 ref.

Descriptors: *Carbon cycle, *Columbia River Estuary, *Estuarine environment, *Food chains, *Grazing, *Nutrient transport, *Phytoplankton, *Primary productivity, Brackish water, Freshwater, Mt St Helens, Respiration.

Mean loss of phytoplankton carbon as a result of microcrustacean grazing ranged from 0.03 to 8.94 milligrams of carbon per cubic meter per day, depending upon time of year and location in the estuary. On an annual basis, median grazing rate estuary. On an annual oasis, meutain grazing rate represented 6.3% of the annual primary production in the estuary. Daily transport of phytoplankton carbon decreased from the fluvial regions to the ocean, with the largest decrease occurring at the ocean, with the largest decrease occurring at the freshwater-brackish water interface. Annual import to the study area from upriver (excluding the May 1980 data, which were affected by the eruption of Mt. Saint Helens) was 61,440 mt of carbon per year, while annual export to the ocean was 40,560 mt of carbon per year. Total phyto-plankton carbon input to the estuary was 91,316 mt was 30,300 mt of cathorh per year. Total phyto-plankton carbon input to the estuary was 91,316 mt of carbon per year, a summation of import from upriver and in situ primary production. Export to the ocean plus median in situ grazing loss equalled 42,453 mt of carbon per year, so that there was an unaccounted balance of 48,863 mt of carbon per year. Some of this was nighttime respiratory loss from the phytoplankton. If the standing stock of the phytoplankton carbon in the estuary was rea-sonably in steady state on an annual basis, the remaining balance must have been satisfied by con-version of phytoplankton carbon to non-chloro-phyllous detrital particulate carbon and/or conver-sion to dissolved organic carbon during transit through the estuary. Some indirect evidence sug-gests that phytoplankton carbon was mainly con-verted to detrital particulate carbon during the gests that phytopiankin carbon was mainly over verted to detrital particulate carbon during the short transit time through the estuary, but verifica-tion requires further data. (Author's abstract) W90-06650

ECOLOGICAL STUDIES ON THE PHYTO-PLANKTON OF BOKNAFJORDEN, WESTERN NORWAY. 1: THE EFFECT OF WATER EX-CHANGE PROCESSES AND ENVIRONMEN-TAL FACTORS ON TEMPORAL AND VERTI-CAL VARIABILITY OF BIOMASS.

Norsk Inst. for Vannforskning, Oslo.

S. V. Erga. Sarsia SARIA3, Vol. 74, No. 3, p 161-176, 1989. 10 fig, 1 tab, 78 ref.

Descriptors: *Biomass, *Boknafjorden, *Ecosystems, *Estuarine environment, *Fjords, *Norway, *Phytoplankton, *Temporal distribution, *Vertical distribution, *Water exchange, Chlorophyll, Diatoms, Nutrient concentrations, Upwelling.

Temporal and vertical variability of phytoplankton biomass were studied throughout 1981 in Boknaf-jorden, a deep-silled fjord of southwestern Norway. Local blooms of autochthonous populations of the diatom Skeletonema costatum found in stratified waters of sheltered areas in late February. The first widespread diatom bloom oc-curred in late March and was probably transported in the brackish 'upper layer' from the Norwegian Coastal Current. A second diatom bloom was ob-Coasia Current. A second unation floorin was ob-served during an upwelling period in early May. After the event, a two-layer system could be rec-ognized. Below the pycnocline shade-adapted cells formed a distinct maximum layer of chlorophyll a. A similar situation appeared in late June, during which autocythonous populations of the coccolith-A similar situation appeared in late June, during which autochthonous populations of the coccolithophorid Emiliania huxleyi made up the major part of the biomass of the 'upper layer'. On June 25 more than 50% of the chlorophyll a content of the upper 40 meters was found deeper than the 1% light depth. Grazing by copepods and very low nutrient concentrations kept the phytoplankton biomass low throughout summer. Mass occurrence of the dinoflagellate Gyrodinium aureolum was executated in the uppergreat of the 'upper encountered in the uppermost part of the 'upper layer' in early October during an inflow of warm and brackish coastal water deprived of nutrients. Very high chlorophyll a/carbon ratios indicate that this species was extremely well-adapted for growth under low irradiances. (Author's abstract) W90-06651

PLANKTON IN THE JAMES RIVER ESTU-ARY, VIRGINIA. V. PHYTOPLANKTON COM-POSITION OF THE NANSEMOND RIVER. Old Dominion Univ., Norfolk, VA. Dept. of Bio-

Orgical Sciences.
C. E. Shomers, and H. G. Marshall.
Virginia Journal of Science VJSCAI, Vol. 40, No.
4, p 193-205, Winter 1989. 6 fig, 2 tab, 19 ref.

Descriptors: *Estuarine environment, *James River Estuary, *Phytoplankton, *Species composition, *Virginia, Chlorophyta, Cryptomonads, Cyanophyta, Diatoms, Dinoflagellates, Euglenoids, Seasonal variation.

The phytoplankton of the Nansemond River contained two major size categories. The most numerous was a ubiquitous pico-nanoplankton component consisting mainly of cyanobacteria, microflagellates and chlorophyceans that were <10 microns in size, with major growth periods in spring and fall. The second group was microplankton that contained cells generally >10 microns and were composed primarily of species from the Bacillariophyceae, Dinophyceae, Cryptophyceae, Chlorophyceae, and Euglenophyceae. This group also had a bimodal abundance pattern occurring in spring and fall. The major phytoplankters in the Nansemond River were primarily estuarine species similar to populations previously reported in the lower James River, its tributaries and the lower The phytoplankton of the Nansemond River consimilar to populations previously reported in the lower James River, its tributaries and the lower Chesapeake Bay. The diatoms had seasonal means of 64.8 ppt and 52.5 ppt of the total biovolume for winter and spring respectively. The Dinophyceae were the most important contributor to biovolume in summer and the fall of 1985. The characteristic phytoplankton in the Nansemond River were not unique, but have a wide distribution within the region and in the lower Chesapeake Bay. (Author's abstract) abstract) W90-06652

EFFECT OF PHYSICAL FACTORS ON THE VERTICAL DISTRIBUTION OF PHYTO-PLANKTON IN EUTROPHIC COASTAL WATERS

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.

A. J. Gabric, and J. Parslow.

Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 5, p 559-569, 1989. 1 tab, 7 fig, 19 ref.

Descriptors: *Coastal waters, *Model studies, *Phytoplankton, Algal growth, Eutrophication, Nearshore processes, Sedimentation rates, Turbidity, Vertical distribution.

A new analytical model for the vertical distribu-tion of phytoplankton in shallow, turbid waters is presented. The effects of vertical mixing, lightpresented. The effects of vertical mining, man-attenuated growth and algal-cell sinking rates are included. The two cases of a finite-depth water column and a mixed layer are investigated. The results for negatively buoyant cells suggest that concentration maxima can occur above the sea bed for either strong or weak mixing in a mixed layer

but are always at the bed in finite-depth waters. Large-celled species with high sinking rates are least sustainable in stable water columns, especially a weakly mixed, mixed layer. Conversely, cell a weakly mixed, mixed layer. Conversely, ceil sinking rates have little effect on net growth in accentuated under weakly mixed conditions. Comparison with field data shows quite good agreement with the model predictions and underlines the fact that simple analytical tools are often quite adequate when dealing with a sparse experimental data base. (Author's abstract) W90-06660

PLUTONIUM, LEAD-210, AND CARBON ISO-TOPES IN THE SAVANNAH ESTUARY: RI-VERBORNE VERSUS MARINE SOURCES. Oak Ridge National Lab., TN. Environmental Sci-For primary bibliographic entry see Field 2J.

90-06663

IMPORTANCE OF MICROALGAE IN THE BIODEGRADATION OF TRIBUTYLTIN IN ESTUARINE WATERS,

Skidaway Inst. of Oceanography, Savannah, GA. For primary bibliographic entry see Field 5B. W90-06664

POLYCYCLIC AROMATIC HYDROCARBONS IN MARINE ORGANISMS FROM ITALIAN CENTRAL MEDITERRANEAN COASTS. Naples Univ. (Italy). Dipt. di Farmacologia Speri-

For primary bibliographic entry see Field 5B. W90-06679

MEDIATORS OF MICROBIOLOGICAL ORIGIN AND EUTROPHICATION PHENOM-

Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France). For primary bibliographic entry see Field 5C. W90-06681

RELATIONSHIP BETWEEN METALS IN SEA-WATER AND METAL ACCUMULATION IN

Nantes Univ. (France). Lab. de Physiologie. For primary bibliographic entry see Field 5B.

EFFECT OF CHLOR-ALKALI INDUSTRY EF-FLUENT ON THE GROWTH AND BIOCHEMI-CAL COMPOSITION OF TWO MARINE MA-CROALGAE. Central Salt and Marine Chemicals Research Inst.,

Bhavnagar (India). For primary bibliographic entry see Field 5C. W90-06683

DISTRIBUTION OF OIL-DEGRADING BACTERIA IN THE NORTHWEST ARABIAN GULF. Basrah Univ. (Iraq). Marine Science Centre. For primary bibliographic entry see Field 5B. W90-06684

METAL LEVELS IN A LEATHERBACK TURTLE. University Coll. of North Wales, Menai Bridge. School of Ocean Sciences. For primary bibliographic entry see Field 5B. W90-06685

COASTAL ZONE: OCCUPANCE, MANAGE-MENT AND ECONOMIC COMPETITIVENESS. HAECON N.V., Ghent (Belgium). For primary bibliographic entry see Field 6F. W90-06686

CONTINENTAL FLUXES TO THE BAY OF BISCAY: PROCESSES AND BEHAVIOUR. Institut de Geologie du Bassin d'Aquitaine, Ta-

Field 2—WATER CYCLE

Group 2L—Estuaries

lence (France). For primary bibliographic entry see Field 2K. W90-06688

HETEROTROPHIC NANNO- AND MICRO-PLANKTON NEAR LARGE SEAPORT CITIES. Akademiya Nauk SSSR, Moscow. Inst. Okeanolo

gii. For primary bibliographic entry see Field 5C. W90-06689

DETERMINATION OF THE METABOLIC AC-TIVITY OF HETEROTROPHIC BACTERIA ISOLATED FROM ESTUARINE GARDNO

Wyzsza Szkola Nauczycielska w Słupsku (Poland). Dept. of Ecology and Protection of Environment. For primary bibliographic entry see Field 2H. w90-0669.

VERTICAL DISTRIBUTION OF ROTATORIA BIOMASS IN BRACKISH WATERS OF THE VISTULA LAGOON.

Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Sanitary Hydrobiology. B. Adamkiewicz-Chojnacka, and S. Radwan. Polskie Archiwum Hydrobiologii PAHYA2, Vol. 36, No. 1, p 105-111, 1989. 4 fig, 12 ref.

Descriptors: *Brackish water, *Distribution pat-terns, *Estuarine ecology, *Rotifers, Baltic Sea, Biomass, Lagoons, Vertical distribution.

Studies on vertical distribution of the predominating Rotatoria species were carried out in the Vistula Lagoon. It is a brackish (0.8-4.5% salinity) and polymictic bay adjacent to the southeastern part of the Baltic Sea. A uniform occurrence of the biomass of each species in the whole water column was found. Slightly elevated values of the surface was found. Singly elevated values of the surface layers of water were found sporadically in some localities. A clear spatial differentiation in the bio-mass distribution of each rotifer species was ob-served; this phenomenon is typical of estuaries. (Author's abstract) 90,06693

ROLE OF LITTER IN NUTRIENT CYCLING IN A BRACKISH TIDAL MARSH.

Smithsonian Environmental Research Center, Edgewater, MD.

T. E. Jordan, D. F. Whigham, and D. L. Correll.

Ecology ECOLAR, Vol. 70, No. 6, p 1906-1915, December 1989. 7 fig, 1 tab, 48 ref. NSF grant BSR-8316948.

Descriptors: *Ammonium, *Cattails, *Cycling nutrients, *Litter, *Marsh plants, *Nitrates, *Phosphates, *Tidal marshes, Decomposition, Nitrites, Sediments.

The role of litter in nutrient cycling in a Typha angustifolia dominated brackish tidal marsh was studied with a field experiment. In replicated plots, litter was either removed, replaced with plastic strips (pseudolitter), increased 3-fold, or left unaltered. One set of plots received fortnightly surface policities of ampositive above here exhibited as on applications of ammonium phosphate solution at an annual rate of 65 g/sq m of N and 72 g/sq m of P. The nutrient additions increased the concentrations of dissolved and extractable ammonium and phosphate, but decreased the concentration of dissolved phate, but decreased the concentration of dissolved intrate plus nitrite in the sediment. The effects of the litter manipulations were mostly attributable to the physical structure of the litter layer rather than the decomposition process. Plots with no litter or pseudolitter developed higher concentrations of total NH4 in the sediment than other plots. Also, when litter and pseudolitter were absent, the nutrient additions caused greater increases in PO4 in the sediment. Decomposition and changes in nutrient sediment. Decomposition and changes in nutrient content of Typha litter were measured in mesh bags placed in the plots containing litter. In plots with increased litter, litter placed on the top of the litter layer decomposed faster than litter placed on the sediment surface. The experimentally manipulated litter took up nutrients during the experiment. The litter in plots with extra litter took up more N and P than was in total NH4 and dissolved PO4 in

the sediment. However, litter decomposition did not affect inorganic N and P pools on the sedi-ment, possibly because large pools of organic N and P in the sediment buffer the supply of inorganic nutrients against short-term changes in litter. (Author's abstract) W90-06707

WATER MASS STRUCTURE AND BOUND-ARIES IN THE MACKENZIE SHELF ESTU-

Institute of Ocean Sciences, Sidney (British Co-

E. C. Carmack, R. W. Macdonald, and J. E. Papadakis.

Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 94, No. 12, p 18043-18055, December 15, 1989. 10 fig, 43 ref.

Descriptors: *Arctic Ocean, *Beaufort Sea, *Continental shelf, *Estuaries, *Mackenzie Shelf Estuary, *Physical properties, *Water masses, Light transmissivity, Plumes, Salinity, Turbidity, Water

The Mackenzie shelf is a broad, estuarine region bordering the southeastern Beaufort Sea in the Arctic Ocean. Its fields of temperature and salinity result from the modification of offshore water result from the modification of offsnore water masses by river inflow, ice melting and freezing, solar insolation, and air-sea exchange. This study relates water masses resident on the Mackenzie shelf to the large-scale oceanography of the Arctic mediterranean. The summertime exchange be-tween the shelf and open ocean is largely confined tween the shelf and open ocean is largely confined to waters lying above the main halocline (S. 432.3 psu), thus excluding underlying offshore waters from the nutrient maximum layer (S approximately 33.1 psu) and Atlantic layer (S. 34.2 psu). Cross-shelf property distributions show that individual water masses maintain their structural identity (i.e., core properties and buoyancy frequency) as they move across the shelf and participate in the estua-rine circulation. Shelf waters are strongly influenced by river inflow; however, the concept of a single 'plume' issuing from the incoming river and single plume issuing from the incoming river and forming a strictly two-layered structure over uniform shelf water is misleading, since a variety of temperature, salinity, and turbidity fronts co-exist on the shelf at any given time. (Author's abstract) W90-06709

COMPOSITION AND MODIFICATION OF WATER MASSES IN THE MACKENZIE SHELF ESTUARY,

Institute of Ocean Sciences, Sidney (British Co-

Iumbia).
R. W. Macdonald, E. C. Carmack, F. A. McLaughlin, K. Iseki, and D. M. Macdonald.
Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 94, No. 12, p 18057-18070, December 15, 1989. 8 fig, 4 tab, 40 ref.

Descriptors: *Arctic Ocean, *Beaufort Sea, *Continental shelf, *Estuaries, *Ice formation, *Mackenzie Shelf Estuary, *Physical properties, *Sea ice, *Water masses, Geochemical model, Nutriest, Plumes, Remote imaging, Runoff, Salinity, Water

The distributions of delta-oxygen-18, salinity, tem-perature, and nutrients were used to quantify water sources to the Mackenzie shelf in the Beaufort Sea. Comparison of water masses with satellite imagery confirms that the meteoric (runoff) water is associated with the Mackenzie plume. The seasonally variable surface layer for the shelf is viewed as cycling between a 'reverse estuary' in winter, when the polar mixed layer (PML) is formed, and a positive estuary in summer when the shelf waters respond to freshwater inputs (runoff and ice melt). A standing stock of 3.7 m fresh water at the end of summer of 1986 is inferred, of which 30% owes its origin to the melting of sea ice; the data coupled with river flow imply a freshwater flushing time for the Mackenzie shelf at about 150 days. To reform the PML during winter requires the remov-al of this seasonal fresh water through the combined processes of flushing and ice formation; once this fresh water has been removed, continued ice growth can produce 'new' brine which would be

observed as a deeper and saltier PML from the previous year. A simple geochemical model shows that autumn conditions (freshwater accumulation) and the rate of flushing are important controls on the potential of the shelf to produce 'new' brine and that winter runoff, were it to distribute evenly across the shelf, is sufficient to inhibit brine production. (Author's abstract)

SPATIO-TEMPORAL DISTRIBUTION OF PO-LYCHAETES IN AN ITALIAN COASTAL LAGOON (LAGO FUSARO, NAPLES), Bioservice Soc. Coop., vico S. Domenico Maggio-re 9, 80134 Napoli (Italy). For primary bibliographic entry see Field 5C. W90-06726

DIEL CHANGES IN THE EGG PRODUCTION RATE OF ACARTIA TONSA (COPEPODA, CA-LANOIDA) AND RELATED ENVIRONMEN-TAL FACTORS IN TWO ESTUARIES. Skidaway Inst. of Oceanography, Savannah, GA. D. E. Stearns, P. A. Tester, and R. L. Walker. Marine Ecology Progress Series MESEDT, Vol. 52, No. 1, p 7-16, February 1989. 3 fig, 3 tab, 27 ref.

Descriptors: *Copepods, *Diurnal variation, *Eggs, *Estuaries, Biological studies, Coastal waters, Light intensity, Pigments, Salinity, Water

Two 48-h field experiments were completed in different USA east coast estuaries to study shortinterval changes in egg production by the coastal copepod Acartia tonsa. In April and June 1986, adult females were collected periodically, sorted into separate glass vials filled with 20 micron or 202 micron filtered seawater, then placed near the 202 micron intered seawater, then placed near the estuarine bottom during the day and at 1 m depth at night to mimic the vertical spatiotemporal loca-tion of the adult A. tonsa population. Field meas-urements of the following factors were made at 3 h urements of the following factors were made at 3 h intervals: egg production, light intensity, water temperature, salinity, concentrations of plant pigments, and A. tonsa gut fullness measured fluorometrically from field-collected, nonexperimental specimens. Copepods in both experiments showed strong nocturnal egg-laying behavior. Changes in temperature, salinity or plant pigments did not explain this behavior, but egg production correlated well with gut fullness measured 24 to 27 h earlier. Differences in daily food consumption, temperature and salinity may explain large site differences in daily egg production rates. (Author's abstract) abstract) W90-06731

VERTICAL DISTRIBUTION OF MICROBIO-LOGICAL AND HYDROGRAPHIC-CHEMICAL PARAMETERS IN DIFFERENT AREAS OF THE BALTIC SEA.

Kiel Univ. (Germany, F.R.). Inst. fuer Meeres-

Marine Ecology Progress Series MESEDT, Vol. 52, No. 1, p 55-70, February 1989. 15 fig, 2 tab, 33

Descriptors: *Baltic Sea, *Marine bacteria, *Sapro-phytic bacteria, *Vertical distribution, Bacteria, Biomass, Denitrification, Enzymes, Hydrogen sul-fide, Microbiological studies, Nitrates, Nitrification, Nitrites, Oxygen.

During 2 cruises with RV 'Poseidon' in August 1982 and August 1986 in the Baltic Sea, a series of vertical profiles between the Fehmarn Belt and the vertical profiles between the Fehmarn Belt and the northern Gulf of Bothnia was investigated. Among the bacteriological variables determined were total bacteria number, bacterial biomass, saprophyte count on different media, turnover rate and maximum uptake velocity of glucose, and, for some stations, extracellular enzyme activity. Highest bacteria numbers and biomass values were always found in the photic one. In the colder, waters found in the photic zone. In the colder waters below the mixed layer all microbiological values decrease. In the boundary layer of the central

Estugries-Group 2L

Gotland Sea, especially between the oxic and anoxic hydrogen sulfide-containing zone, bacteriological values increase markedly. In the water layer above the sediment another increase of bacterial stock and activity measurements was occasionally determined. In the Gulf of Bothnia, where the ally determined. In the Gulf of Bothnia, where the whole water column is sufficiently hearted, only in bottom waters may an increase in bacterial values occur. Depending on the oxygen regime, bacterial nitrogen conversion is very different in the individual areas of the Baltic Sea. Comparison of nitrite and nitrate concentrations shows that nitrification in the Gotland Deep occurs down to the chemocline. Below this a parton dentification, zone cline. Below this a narrow denitrification zone (about 10 m) was found in which nitrate almost completely disappears. In the Gulf of Bothnia, as a result of the favorable oxygen conditions, the nitrification zone extends down to the sea bottom. (Sand-PTT)

MICROBIOLOGY OF A HIGH ENERGY BEACH SEDIMENT: EVIDENCE FOR AN ACTIVE AND GROWING COMMUNITY.

ousie Univ., Halifax (Nova Scotia). Dept. of

Dahlouse University, Indiana M. C. MacSween.

J. A. Novitsky, and M. C. MacSween.

Marine Ecology Progress Series MESEDT, Vol.
52, No. 1, p 71-75, February 1989. 1 fig. 1 tab, 14
ref. National Research Council of Canada Grant A-6548.

Descriptors: *Beaches, *Coastal ecosystems, *Heterotrophic bacteria, *Marine bacteria, *Sand, *Sediments, Biomass, Canada, Microbiological

Microbial biomass, heterotrophic activity, and growth rates were measured in sandy sediments from 2 very different beaches in Nova Scotia, Canada: a protected beach inside Halifax Harbor (HH), and an exposed high energy beach along the coast (LT). Scanning electron microscopy of sand grains revealed that the microbial cells from HH were predominantly cocci whereas the cells from LT were mostly rods. HH sand contained 3.8 times LI were mostly roos. I'll sand contained 3.6 times as many cells (direct count) and 6.9 times as much biomass (ATP) as did LT sand. Likewise, the heterotrophic uptake, rates of nucleic acid synthesis, and the rate of carbon production were all sis, and the rate of carbon production were all several times higher in HH sand than in LT sand. However, on a biomass-specific basis, both sediments had similar activity. Moreover, specific growth rates (5.18/day) were identical. The data indicate that size and total activity of the microbial population depend on the location of the sediment but that growth rate and per cell activity are apparently not affected by abrasion and shear stress. (Author's abstract)

PLANKTONIC AVAILABILITY, MOLT STAGE AND SETTLEMENT OF BLUE CRAB POST-LARVAE. William and Mary Coll., Gloucester Point, VA.

William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science. R. N. Lipcius, E. J. Olmi, and J. Van Montfrans. Marine Ecology Progress Series MESEDT, Vol. 58, No. 3, p 235-242, January 1, 1990. 3 fig. 2 tab, 45 ref. Commonwealth of Virginia, Virginia Sea Grant NA86AA-D-SG042, NSF grant OCE 8700414.

Descriptors: *Aquatic habitats, *Coastal environ-ment, *Crabs, *Larval growth stage, *Plankton, Chesapeake Bay, Ecosystems, Molt stage, Popula-tion dynamics, Settlement.

This study quantified the spatio-temporal variation in the molt stage (developmental state) of the blue crab Callinectes sapidus megalopae (postlarvae), and the relationship between planktonic availability, molt stage and setflement of megalopae during peak settlement in the Chesapeake Bay. Settlement was significantly correlated with the planktonic availability of megalopae. Developmental state of megalopae also appears to be influential in settlement because: (1) blue crab megalopae display quantifiable changes in molt stage; (2) molt stage of megalopae vary on a temporal scale of days to 1 megalopae vary on a temporal scale of days to I month or more; and (3) molt stage of megalopae

advance in collections and plankton, on artificial settlement habitats, and in benthos, indicating the approach to settlement, metamorphosis and a benthic existence. In addition, settlement was not occusarily obligatory until sometime in late pre-molt, as many megalopae collected with the plank-ton were in late premolt. Therefore, megalopae have the time in which to exercise some degree of habitat selection. The findings show that settlement nabitat selection. The findings show that settlement of a benthic invertebrate is regulated partly by the planktonic availability of post-larvae, and that these post-larvae progress through a predictable series of changes in developmental state as they invade settlement habitats. Therefore, a quantitative measure of postlarval development state appears useful in relating planktonic availability of post-larvae to natural settlement patterns. Similar alterations in developmental state occur in the larval and post-larval stages of marine fish and a wide range of invertebrate taxa, indicating the potentially broad applicability of quantitative measures of developmental state in studies of set-tlement. (Author's abstract)

PREDATION RATES ON JUVENILE BLUE CRABS IN ESTUARINE NURSERY HABITATS: EVIDENCE FOR THE IMPORTANCE OF MA-CROALGAE (ULVA LACTUCA).
Rutgers - The State Univ., New Brunswick, NJ.

Center for Coastal and Environmental Studies. Center for Coastal and Environmental Studies.
K. A. Wilson, K. W. Able, and K. L. Heck.
Marine Ecology Progress Series MESEDT, Vol.
S8, No. 3, p 243-251, January 1990. 3 fig. 4 tab, 46
ref. NOAA, Office of Sea Grant, NA85AA-SCORA

Descriptors: *Crabs, *Ecosystems, *Estuaries, *Marine plants, *Predation, *Salt marshes, Coastal environment, Marine algae, Marsh plants, New

Rates of predation on juvenile blue crabs Callin-ectes sapidus (12-64 mm carapace width) in eel-grass Zostera marina, sea lettuce Ulva lactuca, and paired adjacent unvegetated substrates, and a Spar-tina marsh creek were compared using 24 h tether-ing experiments from July to October 1987. Vegepaired adjacent unvegetated substrates, ar tation provided the best cover from predation, with mean predation rates in sea lettuce of 9% and in eelgrass of 20%, compared with mean rates of 40% or greater in unvegetated controls and the marsh creek. Seasonal changes in rates of preda-tion on crabs occurred in eelgrass and sea lettuce tion on crass occurred in elegrass and sea lettuce habitats, indicating that the refuge value of these macrophytes varied seasonally. Sea lettuce, previously considered a poor habitat for decapod crustaceans, provided effective refuge for blue crabs and should be considered a potential nursery habitat. (Author's abstract) W90-06735

IMPACT OF ACCUMULATING DRIFTING MACROALGAE ON A SHALLOW-WATER MACROALGAE ON A SHALLOW-WATER SEDIMENT SYSTEM: AN EXPERIMENTAL STUDY.

Goeteborg Univ. (Sweden). Dept. of Marine Botany.

K. Sundback, B. Jonsson, P. Nilsson, and I. Lindstrom.

Process Series MESED

Marine Ecology Progress Series MESEDT, Vol. 58, No. 3, p 261-274, January 1990. 11 fig, 68 ref.

Descriptors: *Coastal environment, *Marine algae, *Primary productivity, Ammonium, Biological studies, Biomass, Invertebrates, Nutrients, Organic carbon, Oxygen, Particulate matter, Protozoa, Shallow water.

Using an outdoor flow-through experimental set-up consisting of twelve 30 L containers, the effect of accumulation of drifting filamentous macroalgae on a shallow-water sediment system was studied for 3 wk after the addition of 0.9 (low dose) and 1.8 kg fresh wt/sq m (high dose) of filamentous red algae. Effects on the functional level were assessed agae. Effects on the functional level were assessed by measuring primary productivity, changes in carbon pools, as well as oxygen and nutrient flux. The low-dose treatment did not significantly alter the composition or patterns of primary productivity and nutrient fluxes when compared with the

control (no addition). The high-dose addition de-creased the abundance of microalgae, ciliates and meiofauna, whereas no clear trend was seen for bacteria relative to the control. From the oxygen bacteria relative to the control. From the oxygen flux values it was apparent that the systems in control and low-dose containers were autotrophic while in the high-dose treatments the oxygen concentration fell sharply, exhibiting a net oxygen consumption after due to fast mineralization of the macroalgal biomass. The ammonium concentration increased significantly (maximum mean rate 1.4 millimol/sq m/d) and concomitantly with low oxygen values. The content of particulate organic carbon (POC) in the top 5 mm sediment increased carbon (POC) in the top 5 mm sediment increased by 2 g/sq m in both control and low-dose containby 2 g/sq m in both control and low-dose containers due to increased meiofaunal biomass, while in the high-dose treatments the POC content decreased by 2.3 g/sq m. It appears that the influence of accumulating macroalgae on the sediment system depends on the amount and physiologic status of the macroalgae. With a high load of drifting macroalgae in a stagnant situation, the structure and function of the sediment community are strongly affected. No cignificant flow of organic material from the macroalgal mat to the sediment system could be proven. The macroalgal mat apparently constitutes an independent habitat, which influences the sediment community by shading and, when mineralization is fast, by creating unfavorable conditions via low oxygen values. (Author's abstract) W90-06736

HALOGENATED ORGANIC COMPOUNDS FOUND IN SHRIMP FROM THE CALCASIEU ESTUARY.

McNeese State Univ., Lake Charles, LA. For primary bibliographic entry see Field 5B. W90-06759

CHLOROPHYLL A AND RESPIRATORY ELECTRON TRANSPORT SYSTEM ACTIVITY IN MICROPLANKTON FROM THE SURFACE WATERS OF THE WESTERN MEDITERRANE-

Consejo Superior de Investigaciones Científicas, Gerona (Spain). Centro de Estudios Avanzados de

Diances.

R. Martinez, R. A. Arnone, and Z. Velasquez.

Journal of Geophysical Research (C) Oceans

JGRCEY, Vol. 95, No. 2, p 1615-1622, February

15, 1990. 7 fig., 2 tab, 23 ref.

Descriptors: *Chlorophyll a, *Marine environ-ment, *Mediterranean Sea, *Phytoplankton, *Res-piratory electron transport system, *Satellite tech-nology, Circulation patterns, Correlation analysis, Temperature, Water currents.

The distribution of microplankton biomass and the metabolism of surface waters in the western Mediterranean are shown to be strongly associated with the circulation. Chlorophyll a and respiratory electron transport system (ETS) activity of microplankton were measured in surface waters during the Western Mediterranean Circulation Experiment in May and June 1986. Biological signatures, defined by satellite and surface ship measurements, defined complex circulation patterns of surface waters between the Alboran Basin and the Straits of Sicily. Close correlation was found between the distribution of in situ measured surface chlorophyll, ETS activity, ETS/Chl ratio (chlorophyll, ETS activity, ETS/Chl ratios were found located in frontal regions of the Algerian Current and encircling a large anticyclonic eddy. Statistical correlations were performed on in situ and synoptic satellite data. Results show positive correlation between the entered and ETS. correlations were performed on in situ and synop-tic satellite data. Results show positive correlation between chlorophyll and ETS activity and ETS/ Chl ratio and temperature. Excellent correlations ChI ratio and temperature. Excellent correlations were found between in situ chlorophyll and chlorophyll derived from the coastal zone color scanner. Improved statistical correlations were observed by separation of the surface waters based on their salinity into Modified Atlantic Water (MAW) (\$<37) and Mediterranean surface waters (\$>37). MAW with higher chlorophyll and metabolic activity is shown to characterize the circulation of

Field 2-WATER CYCLE

Group 2L—Estuaries

the Algerian Current. The differences in the statistical correlations of these water masses indicate that regional circulation significantly influences the biological functions (Author's abstract) cal functions of microplankton populations. W90-06799

CESIUM 137 TRANSPORT INTO THE ARCTIC OCEAN THROUGH FRAM STRAIT. OLEAN INROUGH FRAM STRAIT.

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.

J. N. Smith, K. M. Ellis, and E. P. Jones.

Journal of Geophysical Research (C) Oceans

JGRCEY, Vol. 95, No. 2, p 1693-1701, February

15, 1990. 4 fig, 2 tab, 31 ref.

Descriptors: *Arctic Ocean, *Cesium, *Industrial wastes, *Ocean circulation, *Oceanography, *Radioactive tracers, *Tracers, *Water currents, Fram

Cesium 134 and 137Cs activities were measured in water samples collected in March-April 1981 at the water samples collected in March-April 1981 at the Fram 3 ice station located 200 km north of Fram Strait. The water depth profiles of these isotopes reveal the presence of two pathways for the entry of anthropogenic tracers into the Arctic Ocean through Fram Strait. Atlantic water passing across the Yermak Plateau at the 100-200 m level is labeled by elevated concentrations of 134Cs and 137Cs associated with inputs from the Sellafield eprocessing plant in the United Kingdom. The 134Cs/137Cs ratio is consistent with a transit time into the Nansen Basin from the Sellafield, United Kingdom, vicinity of 5-6 years. An elevated concentration of 137Cs at the 1500-m level is associated with inputs of recently ventilated water from ed with inputs of recently ventilated water from the Greenland-Norwegian seas or as a consequence of brine formation and off-shelf transport from the Barents Sea. (Author's abstract)

ASSESSMENT OF THE TRANSPORT OF AT-MOSPHERIC CO2 INTO THE ARCTIC OCEAN.

Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemis Goeteborg

For primary bibliographic entry see Field 2K. W90-06801

RESIDENCE TIMES FOR CD AND PO4 IN FUNKA BAY, JAPAN.

Hokkaido Univ., Sapporo (Japan). Dept. of Chemistry. For primary bibliographic entry see Field 2K.

CHEMICAL PROPERTIES OF A LOW-OXYGEN WATER COLUMN IN PORT HACK-ING (AUSTRALIA): ARSENIC, IODINE AND

NUTRIENTS. Melbourne Univ., Parkville (Australia). Marine

For primary bibliographic entry see Field 2K. W90-06804

NUTRIENT DISTRIBUTION AND VARIABILITY IN THE CHARLOTTE HARBOR ESTUARINE SYSTEM, FLORIDA.

Geological Survey, Tampa, FL.
For primary bibliographic entry see Field 5B.
W90-06824

ORGANIC CARBON IN WATERS OF THE WHITE SEA DURING THE SUMMER OF 1994.
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
For primary bibliographic entry see Field 5B.
W90-06957

MACROALGAE AND PHYTOPLANKTON STANDING CROPS IN THE CENTRAL VENICE LAGOON: PRIMARY PRODUCTION AND NUTRIENT BALANCE.
Venice Univ. (Italy). Dept. of Environmental Sci-

For primary bibliographic entry see Field 5C. W90-06975

DISSOLVED ARSENIC SPECIES IN THE SCHELDE ESTUARY AND WATERSHED, BELGIUM.

Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-For primary bibliographic entry see Field 5B.

INFLUENCE OF INTERNAL WAVE INDUCED VERTICAL MIXING ON ICE ALGAL PRO-DUCTION IN A HIGHLY STRATIFIED SOUND.

McGill Univ., Montreal (Quebec). Dept. of Mete-

orology.

R. G. Ingram, J. C. Osler, and L. Legendre.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 29, No. 5, p 435-446, November 1989. 7 fig, 24

Descriptors: *Algal growth, *Ice-water interfaces, *Internal waves, *Sea ice, *Thermal stratification, Algae, Bays, Biomass, Hudson Bay, Salinity currents, Sills, Tidal waves, Tides, Vertical flow, Wave propagation.

Field observations of tidally forced flow over a sill in a constricted region of the highly stratified Manitounuk Sound (Hudson Bay, Canada) were examined during the winter period under a complete landfast ice cover. Necessary conditions for the frequency interest hypersecution were the high frequency internal wave generation over the semi-diurnal tidal cycle for both spring and neap tides were considered. Internal wave activity was found to occur more often on the downstream side of the constriction during flood. A fortnightly variation in upper layer salinity and nutrients was attributed to a similar periodicity in internal wave activity and upward salt transport across the pyonocline. The variation in nutrient levels within the upper layer and at the ice-water interface was thought to have a controlling effect on underice microalgal biomass downstream of the sill. (Au-thor's abstract) W90-07002

ADSORPTION CAPACITY OF PHOSPHORUS IN BALTIC SEA SEDIMENTS. Stockholm Univ. (Sweden). Dept. of Geology. For primary bibliographic entry see Field 2K.

TIGHT COUPLING BETWEEN ENRICHMENT OF IRON AND MANGANESE IN NORTH SEA SUSPENDED MATTER AND SEDIMENTARY REDOX. PROCESSES: EVIDENCE FOR SEASONAL VARIABILITY.
Vrije Univ., Brussels (Belgium).
For primary bibliographic entry see Field 2K. W90-07004

OCCURRENCE AND DISTRIBUTION OF PO-LYCYCLIC AROMATIC HYDROCARBONS IN SURFACE SEDIMENTS AND WATER FROM THE BRISBANE RIVER ESTUARY, AUSTRA-

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.

SEDIMENT STABILIZATION BY HALO-PHILA DECIPIENS IN COMPARISON TO OTHER SEAGRASSES.

National Marine Fisheries Service, Beaufort, NC. Beaufort Lab. For primary bibliographic entry see Field 2J. W90-07007

PORE WATER CHEMISTRY OF RARE EARTH ELEMENTS IN BUZZARDS BAY SEDIMENTS. Woods Hole Oceanographic Institution, MA. For primary bibliographic entry see Field 2J.

W90-07008

W90-07059

TRIBUTYLTIN AND TOTAL TIN IN MARINE SEDIMENTS: PROFILES AND THE APPAR-ENT RATE OF TBT DEGRADATION.

Auckland Univ. (New Zealand). Dept. of Zoolo-

For primary bibliographic entry see Field 5B. W90-07054

SPARTINA ALTERNIFLORA AS A POTEN-TIAL SOURCE OF HEAVY METALS TO THE FOOD CHAIN OF THE SEPETIBA BAY, RIO DE JANIERO, BRAZIL.

Universidade Federal de Sao Carlos (Brazil). Dept. de Ciencias Biologicas. For primary bibliographic entry see Field 5B. W90-07055

SPONGES AS POLLUTION-BIOMONITORS AT ARRAIAL DO CABO, SOUTHEASTERN BRAZIL.

Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biologia.
For primary bibliographic entry see Field 5A.

NITRIFICATION AND NITRATE REDUCTION IN BOTTOM SEDIMENT OF LOUISIANA'S BARATARIAN BASIN.

EGRADAMAN BASIN.
Louisians State Univ., Baton Rouge. Center for Wetland Resources.
R. D. DeLaune, and C. W. Lindau.
Northeast Gulf Science NGSCDE, Vol. 10, No. 2, p 163-167, August 1989. 3 fig, 1 tab, 11 ref. NSF Grant BSR-8414006.

Descriptors: *Bays, *Bottom sediments, *Cycling nutrients, *Nitrates, *Nitrification, *Sedimentwater interfaces, Lake sediments, Marine sediments, Nitrogen, Sediments, Water column.

An understanding of internal nutrient cycling is important in developing loading rates for Louisi-ana's coastal drainage basins. Emphasis must be placed on understanding the various nutrient cycles and related processes occurring within the water column and at the sediment-water interfaces of coastal bays, lakes and channels. The rate of nitrification and nitrate reduction was determined using an isotope dilution technique in sediment-water columns representing two lakes in Louisi-ana's Barataria Basin. Mean nitrification and nitrate reduction rates for sediment-water columns were 39.4 micromols N/cu m·h and 65.0 micromoles N/sq m·h for the Lac Des Allemands (freshwater) and 45.7 and 74.2 micromoles N/sq m·h for Little (brackish) Lake. Appreciable NO3(-) was being produced in the sediment-water columns representing each lake. THe production rate was less than ing each lake. THe production rate was less than the NO3(-) reduction rate. Nitrification was 60% and 62%, respectively, for Lac Des Allemand and Little Lake. The process limiting nitrification and denitrification in such a system is NH4(+) diffusion from bottom sediment to the sediment-water interface where nitrification can occur. The measured rates of reduction and production of NO3(-) for the two study sites, Lac Des Allemands and Little Lake sediment-water columns were similar to published values reported for other estuarine systems where denitrification was found to be a major sink for fixed nitrogen compounds. Nutrient and trophic state of water bodies in upper Baraand trophic state of water bodies in upper Baraand tropins state of water bodies in upper Bala-taria Basin are governed by agricultural and do-mestic nitrogen inputs, but, as shown by this study, nitrification-denitrification processes can act to remove appreciable quantities of nitrogen entering the Basin. (Friedmann-PTT) W90-07079

FAIRWEATHER VERSUS FLOOD SEDIMEN-TATION IN MHLANGA LAGOON, NATAL: IMPLICATIONS FOR ENVIRONMENTAL MANAGEMENT.

National Inst. for Water Research, Congella (South Africa). Natal Regional Lab. For primary bibliographic entry see Field 2J.

W90-07080

EFFICIENT HORIZONTAL TWO-DIMEN-SIONAL HYDRODYNAMIC MODEL.

William and Mary Coll., Gloucester Point, VA.
Inst. of Marine Science.

For primary bibliographic entry see Field 7C. W90-07093

HERBIVORES AND THE SPATIAL DISTRIBU-TION OF THE PHYTOPLANKTON: II. ESTI-MATING GRAZING IN PLANKTONIC ENVI-RONMENTS.

Brookhaven National Lab., Upton, NY. Oceanographic Sciences Div. C. D. Wirick.

Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 74, No. 3, p 249-259, 1989. 4 fig, 2 tab, 23 ref. DOE Contract DE-AC02-76CHOOO16.

Descriptors: *Copepods, *Ecosystems, *Error analysis, *Limnology, *Marine biology, *Mathematical models, *Phytoplankton, *Plankton, Probability distribution, Spatial heterogeneity.

Plankton ecologists routinely extrapolate results from laboratory experiments to field situations. Large errors are made when laboratory measurements of herbitagetters and the plant of herbitagetters. Large errors are made when laboratory measure-ments of the ingestion rate of herbivorous zoo-plankton are used to estimate grazing in planktonic environments. The errors arise because the spatial heterogeneity in natural plankton distributions is greater than the heterogeneity present in laboratory experiments. Two probability models are developed for extrapolating laboratory measurements of ingestion to planktonic environments. Both models require sample statistics of the plankton distribu-tion of marine plankton. One model predicts labo-ratory measurements overestimate the ration obratory measurements overestimate the ration of tained by an individual copepod by 30%. A second model predicts errors exceeding plus or minus 50% are possible when laboratory measurements are model predicts errors exceeding plus of minus 30% are possible when laboratory measurements are used to estimate the grazing by a population of copepods. (Author's abstract)
W90-07097

PHYTOPLANKTON DISTRIBUTION IN A FRONTAL REGION OF TOKYO BAY, JAPAN IN NOVEMBER 1985.

Tokyo Univ. (Japan). Ocean Research Inst. M. S. Han, K. Furuya, and T. Nemoto. Journal of the Oceanographical Society of Japan NKGKB4, Vol. 45, No. 5, p 301-309, October 1989. 7 fig, 2 tab, 13 ref.

Descriptors: *Japan, *Phytoplankton, *Salinity, *Spatial distribution, *Species composition, *Tem-perature, *Tokyo Bay, Diatoms, Dinoflagellates, Kenzaki offshore front, Nitrates, Nitrites, Yokosuka inshore front.

Phytoplankton distribution in a frontal region of Tokyo Bay was investigated in relation to hydrography in November 1985. The frontal region was observed from the central to the mouth area of the bay and consisted of fine scale discontinuities of salinity and temperature. Among them the Kenzaki offshore front (KOF) and the Yokosuka inshore front were most prominent in terms of the duration and the magnitudes of the hydrographic gaps. Three major phytoplankton assemblages were observed: (A) neritic and offshore diatoms in the mouth area of Tokyo Bay, (B) a diatom Leptocylindrus danicus and dinoflagellates in the central lindrus danicus and dinoflagellates in the central area, and (C) bloom forming cryptophyceans, dinoflagellates and Leptocylindrus danicus from the inner Tokyo Bay. The KOF was approximate boundary of the outside assemblage (A) and the intermediate (B), and the YIF was that of (B) and the inner bay population (C). Species changes across the fronts were rather gradual in the KOF making strong to distinct jumps in temperature, salinity, in vivo chlorophyll fluorescence and nivete plus nitrite. An outward surface flow of the sammy, in vivo cholopyin hubreschee and intrate plus nitrite. An outward surface flow of the inside population along the western coast off Yokosuka was detected. (Author's abstract) W90-07102

EFFECTS OF HOPPER DREDGING AND SEDIMENT DISPERSION, CHESAPEAKE

BAY.
Virginia Inst. of Marine Science, Gloucester Point. For primary bibliographic entry see Field 4C. W90-07189

PHTHALATE ESTER SPECIATION IN ESTUA-RINE WATER, SUSPENDED PARTICULATES AND SEDIMENTS.

Liverpool Univ. (England). Oceanography Lab. For primary bibliographic entry see Field 5B. W90-07195

INFLUENCE OF BEDROCK GEOCHEMISTRY ON THE HEAVY METAL CONTENT OF STREAM WATER, MARINE WATER, MARINE SEDIMENTS AND ORGANISMS IN ST. JOHN, USVI.

Center for Energy and Environment Research, San Juan, PR.
For primary bibliographic entry see Field 2K.
W90-07238

COMPARISON OF THE FISH COMMUNITIES IN NEARBY PERMANENTLY OPEN, SEA-SONALLY OPEN AND NORMALLY CLOSED ESTUARIES IN THE SOUTH-WESTERN CAPE,

Cape Town Univ. (South Africa). Dept. of Zoolo-

B. A. Bennett.

South African Journal of Marine Science SJMSE7, Vol. 8, p 43-55, 1989. 7 fig, 7 tab, 43 ref.

Descriptors: *Estuaries, *Fish populations, Bot Estuary, Fish, Kleinmond Estuary, Palmiet Estuary, Population dynamics, Seasonal variation, South Africa, Species diversity.

Seine-netting for 13 consecutive months in the permanently open Palmiet Estuary, in the seasonalju open Kleinmond Estuary, and in the Bot Estuary, which had been closed for three years, yielded
10/1,000 fish. Seven species complete their entire
10/1/16 cycles in estuaries, 13 breed in the sea and
migrate into the estuaries as juveniles, and two
were freshwater species. Classification and ordination showed that the structure of the communities
changed markedly during heavy freshwater flushchanged markedly during heavy freshwater flush-ing in the Palmiet and Kleinmond estuaries but not in the Bot. This was related to a massive emigrain the Bot. It is was related to a massive enlight-tion of species and individuals in the former two systems. Spawning by the permanent residents in spring/summer ensures minimal loss of eggs and larvae from the estuaries and allows juveniles to benefit from favorable summer and autumn condi-tions. Winter spawning by the marine migrants allows juveniles to enter the estuaries in the spring anows juveniles to enter the estuaries in the spring and early summer, after the winter floods but before the estuaries close. Differences in the species composition of the three estuaries are related to differences in the duration of connection between the estuaries and the sea. (Author's abstract) W90-07243

OBSERVATIONS OF THE OCEANIC ENVIRONMENT AND WARM-WATER OUTFALL NEAR THE KOEBERG NUCLEAR POWER STATION, SOUTH AFRICA.

Cape Town Univ. (South Africa). Dept. of Ocean-

ography. M. R. Jury, and C. A. Bain. South African Journal of Marine Science SJMSE7, Vol. 8, p 67-89, 1989. 14 fig, 1 tab, 69 ref.

Descriptors: *Heated water, *Koeberg Nuclear Power Station, *Outfall, *Path of pollutants, *Thermal pollution, *Upwelling, *Wave action, Mixing, Water temperature, Wind waves.

The oceanographic dynami Power Station are investigated by means of spatial observations over a 10-km domain and time-series analysis at scales of hours to months. The background environmental data set used for the siting and engineering design aspects includes analyses of sea temperatures, winds and waves in the nearshore zone. The relationship between winds and coastal upwelling is established and statistical analyses reveal prominent cycles at 24 hours and 5-20 days. The extent trajectory and 5-10 days. days. The extent, trajectory and dilution of the heated effluent water discharged by Koeberg in its operational mode is studied by means of field observations. Intensive surveys, made under various conditions, show that the warm plume mixes via inherent turbulence and wave action. Wave action and the breakwater structure cause the plume to drift southwards along the beach. Farther offshore, drift southwards along the beach. Farther offshore, the buoyant plume spreads laterally, halving the sea temperature excess. Outside the surf zone, the diluted water remains at the surface and is advectdiluted water remains at the surface and is advectively wind-driven currents. Ambient conditions appear to be maintained along the sea bed except within 500 m of the outfall, and the potential for ecological impact by the warm plume is therefore spatially limited. (Author's abstract)

W90-07244

SEA TEMPERATURE VARIATIONS IN THE TSITSIKAMMA COASTAL NATIONAL PARK, SOUTH AFRICA, WITH NOTES ON THE EFFECT OF COLD CONDITIONS ON SOME FISH POPULATIONS.

Tsitsikamma Coastal National Park, P.O. Storms River 6308, South Africa.

N. Hanekom, L. Hutchings, P. A. Joubert, and P. C. Van Der Byl.

South African Journal of Marine Science SJMSE7, Vol. 8, p 145-153, 1989. 7 fig, 1 tab, 26 ref.

Descriptors: *Fish populations, *South Africa, *Tsitsikamma Coastal National Park, *Water temperature, Coastal waters, Population dynamics, Seasonal variation

From sea surface temperature records for the Storms River area, South Africa, between 1978 and 1984, a mean of nine major declines (up to 3 C or more within 48 h) per annum were recorded, 81% between November and April. Continuous temperature records were made at 12 and 22 m during summer 1983/84, and 90% of the temperature declines (up to 1 C or more) were found to occur during or just after (up to 3 days) easterly (NE-SE) winds. Also, there was a marked tendency (c. 75%) for temperatures at the surface and 12 (NE-SE) winds. Also, there was a marked tenden-cy (c. 75%) for temperatures, at the surface and 12 m deep, to decrease during the first day of these winds and, conversely, to increase during the first day of westerly (NW-SW) winds. Cool conditions in January 1984 resulted in the death of 14 fish species and, for some of the species, the rapidity of the temperature decline appeared to be the deter-minant factor. A comparison of rock and estuarine angling extress for the Tsitiskamma region during angling catches for the Tsitsikamma region during summers experiencing warm (1983) and cold (1984) sea conditions suggests that Pomatomus sal-tatrix (bluefish, or elf) migrate into the Keurbooms Estuary during cold upwelling events. (Author's abstract) W90-07245

ORGANOCHLORINES IN BOTTLENOSE DOLPHINS TURSIOPS TRUNCATUS FROM THE EAST COAST OF SOUTH AFRICA.

Port Elizabeth Museum, Humewood (South Africa).

For primary bibliographic entry see Field 5B. W90-07246

COMPOSITION, SPECIES RICHNESS AND SIMILARITY OF ICHTHYOFAUNAS IN EEL-GRASS ZOSTERA CAPENSIS BEDS OF SOUTHERN AFRICA.

J.L.B. Smith Inst. of Ichthyology, Grahamstown

A. K. Whitfield, L. E. Beckley, B. A. Bennett, G. M. Branch, and H. M. Kok. South African Journal of Marine Science SJMSE7, Vol. 8, p 251-259, 1989. 3 fig, 4 tab, 43 ref.

Descriptors: *Estuaries, *Fish populations, *Sea grasses, *Species diversity, Biological studies, Classification, Coastal waters, Literature review, Population density.

Field 2—WATER CYCLE

Group 2L—Estuaries

This study collates published and unpublished data on the ichthyofaunas associated with beds of eelgrass Zostera capensis in eight estuaries and one lagoon in southern Africa. These macrophyte beds are utilized predominantly by small teleosts; both species breed in the estuary and juvenile marine fish. By far the most abundant of the 97 species of fish recorded in these beds were Atherina breviceps, Gilchristella aestuaria, Liza dumerilii, Liza richardsonii and Rhabdosargus holubi. Classification grouped the ichthyofaunas of the six warmrichardsonii and Rhabdosargus holubi. Classifica-tion grouped the ichthyofaunas of the six warm-temperate estuaries in the South-Eastern and Southern Cape at a similarity level > 50%. Ordina-tion produced a similar clustering and also demon-strated that the subtropical Richards Bay and warm-temperate Mngazana estuary, together with the cold-temperate Langebaan Lagoon, were out-liers. Classification and ordination showed that, within an estuary, the ichthyofaunas of dense and narsez Zostera areas were more similar than either sparse Zostera areas were more similar than either was with those of non-vegetated areas. The species richness of fish within eelgrass habitats along the southern African coast tended to decrease from north-east to south-west, a trend attributable to an north-east to south-west, a trend attributable to an attenuation in the number of tropical/subtropical Indo-Pacific species. The numerically dominant fish families in eelgrass beds in South Africa showed a greater degree of overlap with those of south-eastern Australia than with those of either southern Japan or eastern North America. (Author's abstract) thor's abstract) W90-07247

INHIBITION OF FERTILIZATION IN THE SEA URCHIN PARECHINUS ANGULOSUS BY ORGANIC POLLUTANTS: CORRELATION WITH MOLECULAR VALENCE CONNECTI-

Cape Town Univ. (South Africa). Dept. of Zoolo-

gy. For primary bibliographic entry see Field 5C. W90-07248

NOTE ON THE EFFECTS OF A FLOOD OF MEDIUM INTENSITY ON MACROBENTHOS OF SOFT SUBSTRATA IN THE SWARTKOPS ESTUARY, SOUTH AFRICA

Port Elizabeth Univ. (South Africa). Dept. of Zo-

South African Journal of Marine Science SJMSE7, Vol. 8, p 349-355, 1989. 2 fig, 2 tab, 17 ref.

Descriptors: *Benthic environment, *Flood flow, *Macroinvertebrates, Biological studies, Estuaries, Mortality, Population dynamics, Salinity, Swart-kops Estuary.

The intensity and effects of a flood in September-October 1975 on certain macrobenthic species of October 1975 on certain macrobenthic species of the soft substrata of the Swartkops Estuary were assessed. Significant decreases were recorded in populations of the bivalve Solen cylindraceus and the prawns Upogebia africana and Callianassa kraussi in the middle and upper reaches. The re-ductions were respectively some 93%, 49% and 28% of the pre-flood values. No decrease was noted in populations of the bivalve Dosinia hepati-ca in the middle reaches or of U. africana in the ca in the middle reaches or of U. africana in the lower reaches. Both large and small S. cylindraceus and C. kraussi were apparently affected by the flood, but in the case of U. africana it was primarily small individuals that suffered. Under flood conditions, U. africana and C. kraussi were either evacuating their burrows or being flushed out by the strong freshwater flow. The mean salinity (9 ppt) of the mantle cavity fluids taken from S. cylindraceus during the 1975 flood was below the lower tolerance level of the species (c. 13 ppt), and mortalities are therefore assumed to be the result of hypo-osmotic stress (Author's abstract) hypo-osmotic stress. (Author's abstract) W90-07249

CHANGES IN PLANKTON COMMUNITIES IN REGULATED REACHES OF THE LOWER RHINE RIVER.

Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 6G. For primary bibliographic entry see Field 6G. W90-07336

SOURCES AND CHARACTERISTICS OF FULVIC AND HUMIC ACIDS FROM A SALT MARSH ESTUARY.
Georgia Univ., Sapelo Island. Marine Inst

or primary bibliographic entry see Field 2K. 790-07386

HUMIC SUBSTANCES IN A CATENA OF ES-TUARINE SOILS: DISTRIBUTION OF OR-GANIC NITROGEN AND CARBON.

GANDEN AND CARBON.

Instituto de Investigaciones Agrobiologicas de Galicia, Santiago (Spain).

For primary bibliographic entry see Field 2K.

W90-07387

HEAVY METAL POLLUTION INDUCED BY A FERRO-NICKEL SMELTING PLANT IN

Athens Univ. (Greece). Zoological Lab. and Museum. For primary bibliographic entry see Field 5B. W90-07392

MERCURY LEVELS IN TOTAL SUSPENDED MATTER AND IN PLANKTON OF THE MEDI-TERRANEAN BASIN.

I ERRANEAN BASIN. Istituto di Biofisica, Pisa (Italy). For primary bibliographic entry see Field 5B. W90-07393

TRACE METALS IN SEDIMENTS FROM THE ADRIATIC SEA.
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
Center for Marine Research.

For primary bibliographic entry see Field 5B. W90-07394

RADIONUCLIDES IN SHORELINE WATERS

OF THE NORTHEAST IRISH SEA.

UKAEA Atomic Energy Research Establishment,
Harwell (England). Environmental and Medical
Sciences Div. For primary bibliographic entry see Field 5B. W90-07395

INFLUENCE OF VENICE LAGOON MACRO-FAUNA ON NUTRIENT EXCHANGE AT THE SEDIMENT-WATER INTERFACE.

Venice Univ. (Italy). Dept. of Environmental Sci-

R. Donazzolo, D. Degobbis, A. Sfriso, B. Pavoni, and A. A. Orio.

and A. A. Orio. Science of the Total Environment STENDL, Vol. 86, No. 3, p 223-238, October 1989, 5 fig. 4 tab, 27 ref. EEC Grant ENV-751-I-SB. CNR (Rome) Grant 83.02334.03.

Descriptors: *Bays, *Benthic fauna, *Cycling nutrients, *Eutrophication, *Sediment-water interfaces, *Venice Lagoon, Bioturbation, Interstitial water, Macroinvertebrates, Marine sediments, Nitrogen, Nutrients, Oxidation-reduction potential, Phosphorus

To estimate the relative contribution of macrofauna bioturbation to the nutrient release rate relative to other processes (e.g., diffusion, influence of microorganisms), a representative set of Venice Lagoon benthic organisms were added to a large laboratory sediment-water experimental system and nutrient release rates were measured both with and without macrofauna. Venice Lagoon benthic macrofauna, in an experimental laboratory system (0.2 by 0.4 by 0.8 m), significantly affected nutrient exchange at the sediment-water interface. After macrofauna addition, the inorganic nitrogen release rate from the sediment increased by an order of magnitude compared with the values obtained in of magnitude compared win the values obtained in the undisturbed experimental system (from 1.7 to 23 millimoles/sq m/day), while a two-fold to three-fold increase was observed for reactive phos-phorus (from 0.26 to 0.7 millimoles/sq m/day). In this system, the sediment redox potential and nutrient concentrations in the interstitial waters were similar to those observed in situ in the lagoon. (Author's abstract) W90-07402

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

OPERATING EXPERIENCE OF AN R. O. PLANT AS PRETREATMENT OF THE DEMINERALIZER SYSTEM IN A COGENERATION PLANT.

Power Resources, Inc., Big Spring, TX. K. Hamby, and J. Chen. Desalination DSLNAH, Vol. 76, No. 1-3, p 3-14, November 1989. 2 fig, 8 tab.

Descriptors: *Boiler water, *Demineralization, *Desalination apparatus, *Electric powerplants, *Pretreatment of water, *Reverse osmosis, *Texas, Cost repayment, Desalination plants, Membranes, Powerplants, Steam turbines, Water treatment, Water treatment facilities

In May, 1988, Power Resources Inc. installed a 550 gallons per minute Reverse Osmosis System at the C. R. Wing Cogeneration Plant in Big Spring, Texas. The Reverse Osmosis System was provided lexas. The Reverse Osmosis system was provided as a pretreatment of the existing demineralizer to lengthen the demineralizer runs and effectively increase the plant's overall boiler water makeup capabilities. The system was also intended to significantly reduce the costs associated with the boiler feed water treatment. Regeneration cycle boiler feed water treatment. Regeneration cycle time of a demineralizer was extended from approximately 9 hours to almost 336 hours, resulting in a substantial savings of the chemicals used for regeneration and minimum regenerant for deep well disposal. The Reverse Osmosis System installed at the C. R. Cogeneration Plant is functioning as intended. Because demineralizer runs are currently approximately 10 days in length, one band of the system is turned off when the demineralizer storage tank is full. It is estimated that most of the time the reverse osmosis system is running 50% of its capacity. Payback of the capital investment in this Reverse Osmosis System was calculated to be less than two years. (Mertz-PTT)

GRAPHIC EVOLUTION OF THE 24,000 HOURS (3 YEARS), OPERATING DATA OF A RO BRACKISH WATER DESALINATION PLANT, IN LAS PALMAS, CANARY ISLANDS, SPAIN.

Universidad Politecnica de Canarias, Las Palmas de Gran Canaria (Spain). Escuela Tecnica Superior de Ingenieros Industriales de Las Palmas. E. R. Ruiz Saavedra.

Desalination DSLNAH, Vol. 76, No. 1-3, p 15-26, November 1989. 6 fig, 3 tab.

Descriptors: *Brackish water, *Desalination, *Desalination plants, *Reverse osmosis, *Spain, *Water treatment facilities, Desalination apparatus, Membrane processes, Performance evaluation,

The capacity of the reverse osmosis brackish water desalting plant in Las Palmas, Canary Islands, Spain is 370 cubic m/day. Since January 1986 it has been operating without using acid pretreatment and using only Flocon.100 antiscalant. The reverse osmosis system is equipped with Filmtee BW30-8040 reverse osmosis elements. Examination of the first three years of the plant's operation showed that the use of acid in the pretreatment leads to a that the use of acid in the pretreatment leads to a greater percentage of recovery, which could also cause a greater operating pressure. However, for convenience and simplicity of maintenance, and to avoid posttreatment of the product water, it was required that acid pretreatment not be used. In the required that acid pretreatment not be used. In the future the pretreatment stage will be reduced; this will minimize the use of acid. Then, it will be important to get practical information on systems without acid pretreatment. After the first three years of operation of the plant, a chemical cleaning will take place following the instructions of the manufacturer of the membranes, so that the level

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

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of the membrane compaction can be measured accurately. (Mertz-PTT) W90-06558

REVERSE OSMOSIS AND ION EXCHANGE DEMINERALIZER SYSTEM FOR BASRAH PETROCHEMICAL COMPLEX NO. 1.
G. Ali, J. H. Dalton, P. D. Judges, and C. Tao. Desalination DSLNAH, Vol. 76, No. 1-3, p 27-37, November 1989. 1 fig. 1 tab, 4 ref.

Descriptors: *Demineralization, *Desalination, *Desalination apparatus, *Desalination plants, *Ion exchange, *Iraq, *Reverse osmosis, *Water treatment, Boiler water, Industrial plants, Pretreatment of water, Shatt Al-Arab River, Water quality trends, Water treatment facilities.

The advancement of reverse osmosis technology and equipment manufacturing has now made it economically competitive with other water treatment systems. The selection of reverse osmosis system for Basrah Petrochemical Complex No. 1, Basrah, Iraq was based on its better overall economy. Basrah Petrochemical Complex No. 1 takes its water supply from the Shatt-Al-Arab River. Since the initial startup in 1980, the water treatment system has been faced with continued deterioration of the river water quality. Modification of the water treatment system became necessary to rectify the problem resulting from significant increases of total dissolved solid concentration in the raw water supply. The original water treatment system consisted of pretreatment of oil, solids removal and chlorination at the Shatt-Al-Arab River intake, primary treatment by clarification and sand filtration, and secondary treatment by Zeolite softening and flash evaporation. This was coupled with ion exchange demineralization of boiler feedwater make-up and process water usage at the Complex. An additional treatment system was needed between the primary and secondary water treatment facilities. Three alternative treatment schemes were considered. In all three cases the reverse somosis permeate was to be used as cooling water makeup and the existing Zeolite softener bypassed. Significant modification of the existing water treatment facilities was required. Results of the investigation indicated that a reverse comosis system with a new coarse demineralizer system offered the best economy. (Mertz-PTT)

THM PRECURSOR REMOVAL AND SOFTEN-ING--FT, MYERS 12 MGD RO MEMBRANE PLANT, FLORIDA 180A. Hudranguites San Disea CA

Hydranautics, San Diego, CA. For primary bibliographic entry see Field 5F. W90-06560

'DESIGN OF COMPACT, CONTAINERIZED DESALINATION PLANTS' EXECUTED FOR MINISTRY OF ELECTRICITY AND WATER, KUWAIT.

Hydrotechnik, Salzburg (Austria).
Desalination DSLNAH, Vol. 76, No. 1-3, p 53-60,
November 1989.

Descriptors: *Brackish water, *Desalination, *Desalination apparatus, *Desalination plants, *Kuwait, *Water treatment facilities, Drinking water, Foreign design practices, Membranes, Performance evaluation, Reverse osmosis, Water treatment.

On August 8, 1987 Hydrotechnik signed a contract with the Ministry of Electricity and Water, Kuwait, for the supply, erection and commissioning of 13 containerized mobile Brackish Water Reverse Osmosis Desalination Plants with a capacity of 13 times 1136 cubic m/day. The units, which draw brackish water from the ground water system, serve as Emergency Units for hospitals and other important government installations. Only six months after the date of signing the contract, the first Reverse Osmosis Unit, consisting of one 20-foot pretratment-filtration container, one 40-foot operation container, one 40-foot storage container, two 50,000 imperial gallons raw water/product water tanks, and complete civil work and erection

had passed the initial reliability test and went into commercial operation. On November 13, 1988, 15 months after signing the contract, all 13 units had been successfully put into operation, each unit thereby passing a 110 day reliability test. Up to publication of this paper, all units were operating to the satisfaction of the customer, producing drinking water with a salinity which was far below the limits of the World Health Organization standard. For example, the first unit had a record of 9850 operation hours as per April 1988. (Author's abstract)

DESAL-5 MEMBRANE FOR WATER SOFTEN-ING.

Desalination Systems, Inc., Escondido, CA. For primary bibliographic entry see Field 5F. W90-06562

JEDDAH 1 RO PLANT-PHASE I 15 MGD RE-VERSE OSMOSIS PLANT.

Saline Water Conversion Corp., Jeddah (Saudi Arabia). M. Muhurji, G. Faggard, V. Van Der Mast, and H.

M. Munurji, G. Paggard, V. Van Der Mast, and H. Imai. Desalination DSLNAH, Vol. 76, No. 1-3, p 75-88, November 1989. 6 fig, 4 tab.

November 1989. 6 fig, 4 tab.

Descriptors: *Desalination. *Desalination plants.

Descriptors: *Desalination, *Desalination plants, *Reverse osmosis, *Saudi Arabia, *Water treatment, *Water treatment facilities, Filters, Membranes. Performance evaluation. Seawater.

The largest seawater reverse osmosis desalination plant in the world has been constructed at Jeddah in Saudi Arabia. It has been successfully operating stone April, 1989. The 15 million gallon/day (36,800 cubic m/day) seawater reverse osmosis plant consists of the following systems: seawater supply system, dual media filter and micron cartridge filters, high pressure pumps and reverse osmosis trains, product delivery, chemical addition, electrical power supply, central control room, and auxiliary systems. Based on 500 hours of operation, it has been confirmed that all plant requirements have been exceeded. Plant production per train was specified at 1.5 million gallons/day (237 cubic m/hour) at a maximum design pressure of 70 kg/square cm x gram. Actual production of the plant far exceeds these requirements. Presently, production is maintained at a nominal production of 1.5 million gallons/day per train by reducing the inlet pressure. (Mertz-PTT)

INTEGRATED PRODUCTION OF POWER AND WATER.

Saline Water Conversion Corp., Al-Khobar (Saudi Arabia). For primary bibliographic entry see Field 5F. W90-06564

CONCENTRATION OF RO-BRINES BY SEEDED HORIZONTAL TUBE FALLING FILM EVAPORATION (HTFE).

Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Verfahrenstechnik 1 und Inst. fuer Verfahrenstechnik.

R. Rautenbach, and J. Gebel.
Desalination DSLNAH, Vol. 76, No. 1-3, p 107119, November 1989. 9 fig, 16 ref.

Descriptors: *Brackish water, *Brines, *Desalination, *Desalination apparatus, *Evaporators, *Reverse osmosis, *Water treatment, Brine seeding, Evaporation, Flash evaporation, Magnesium hydroxide, Silica, Sulfates, Water treatment facilities.

Horizontal tube multiple effect has proved to be reliable, energy-efficient and capital cost-efficient in a number of medium sized seawater desalination plants. The stacked version, especially the brine distribution by sieve trays, has optimal stack design with respect to low vapor side pressure losses and the efficient removal of noncondensibles. This design might be of use for the concentration/crystallization of brines from brackish water reverse osmosis plants, though there is a question

whether it would operate in the supersaturated range with respect to components like calcium sulfate, magnesium hydroxide and silica. For large brackish water desalination plants far inland the concentration of the reverse osmosis brines has become essential since the waste of about 20% of the water can no longer be afforded and since the area required for the large solar evaporation ponds is often not available. Scaling of evaporation heat transfer surface can be controlled in this concentration range only by either a seeding or a fluidized bed technique. Fluidized bed technique is presently restricted to vertical tube heat exchangers/flash evaporator systems. Seeding in combination with horizontal tube/falling film evaporators is superior to most other evaporator designs with respect to investment costs and energy consumption because of its simple brine distribution (sieve plates) and its high overall heat transfer coefficients. The presence of seeding crystals in the brine has no negative effects on film formation. (Mertz-PTT)

TECHNOECONOMICS OF POWER/DESALT-ING COGENERATION PLANTS IN KUWAIT--A PRELIMINARY STUDY.

Kuwait Water Resources Development Centre, Safat

A. A. J. Al-Zubaidi.

Desalination DSLNAH, Vol. 76, No. 1-3, p 121-154, November 1989. 17 fig, 5 tab, 13 ref.

Descriptors: *Cost allocation, *Desalination plants, *Electric power production, *Kuwait, *Powerplants, Available energy method, Water treatment, Water treatment facilities.

Cogeneration power/desalting plants offer economic advantages over single-purpose plants. These advantages are derived from more efficient utilization of fuel and savings in capital investment costs of common components. Two basic cost allocation methods have been established. These are the credit and available energy methods. While most previous published studies have adopted the credit method, relatively few have tackled the available energy method will typically predict power and water cost values from a totally impartial standpoint, it has the disadvantage of being complex. Cogeneration systems design based on extraction-condensing steam turbines and multi-stage flash plants results in comparatively very competitive and flexibility in plant operation required to meet variable demands. At maximum water production rating, the power unit cost decreases with increasing power/water ratio. The rate of decrease is variable, depending on the range of power/water ratio exists which results in the lowest water unit cost. The optimum power/water ratio exists which results in the lowest water unit cost. The optimum value for power/water ratio ites steween 4124.5 and 5000 KW/1000 cubic m/day. (Mertz-PTTT)

OPTIMIZATION OF DUAL-PURPOSE STEAM POWER AND MSF DESALINATION PLANT. Consulting Engineers, P.O. Box 223, Heliopolis, Cairo, Egypt.

Colino, Egypt.
M. H. Ali El-Saie.
Desalination DSL NAH, Vol. 76, No. 1-3, p 155175, November 1989. 8 fig, 5 tab.

Descriptors: "Cost analysis, "Desalination plants, "Electric power, "Electric power costs, "Multistage flash distillation, "Thermal powerplants, Electric power production, Optimization, Persian Gulf, United Arab Emirates, Water production.

One of the main targets in the design stage of a dual-purpose steam power and large multistage flash desalination plants of known outputs is the determination of the lowest performance ratio for the desalination plant to ensure lower capital and operating costs, after selection of the system, based on thermodynamic and economic comparisons. After determining the best size and performance ratio of the desalination units, the following ele-

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

ments were considered for the calculation of the water production cost: capital cost of the plant including civil engineering, cost of heat, cost of electricity, cost of chemicals, plant economic life, interest rate, and utilization factor of the plant. A preliminary study for a 400 megawatt steam power and 48 million imperial gallon/day plant for Abu Dhabi, Arabian Gulf was conducted. The main concern was to determine the lowest performance ratio of the desalination plant. Sensitivity analysis showed that if cost of heat was doubled then an optimum performance ratio of 7 was recommended provided enough steam was available from the turbines. The unit capacity of 7/8.4 million imperial gallons/day gives the most economic solution. However, this capacity is about 17% bigger than units currently in commercial production. With good specification and control during the design stage and a prototype test or mathematical analysis, there should be no risk on having a reliable unit plant of 7/8.4 million imperial gallons/day. (Mertz-PTT)

OPTIMUM DESIGN FOR A HYBRID DESALT-

ING PLANT. King Saud Univ., Riyadh (Saudi Arabia). Coll. of Engineering.

I. S. Al-Mutaz, M. A. Soliman, and A. M. Daghthem.

Desalination DSLNAH, Vol. 76, No. 1-3, p 177-187, November 1989. 2 fig, 1 tab, 3 ref.

Descriptors: *Cost analysis, *Desalination, *Desalination plants, *Multistage flash distillation, *Reverse osmosis, Desalination apparatus, Design criteria, Membrane processes, Optimization, Water treatment, Water treatment facilities.

Dual-purpose multistage flash desalination plants provide freshwater with low cost at high desalting capacity, but require high installation costs. Two-stage reverse osmosis desalination plants require only half the multistage flash installation cost while producing water at a comparable price. By combining a sea water reverse osmosis plant with the dual purpose multistage flash plant, the capital and operating cost can be reduced and the excess power can be efficiently utilized. The design parameters for such a hybrid plant will be the operating pressure and water recovery of the reverse osmosis plant and the number of stages and heat transfer areas for the multistage flash plant. The objective is to minimize the cost of water satisfying maximum total dissolved salt criteria. If high pressure membranes that can stand a pressure higher than 80 atmospheres are developed and become reliable and as fuel cost of \$18/barrel, water produced from multistage flash is cheaper, whereas at a fuel cost of \$27/barrel, water from reverse osmosis plants is marginally cheaper. It is concluded from this study that the savings obtained from scaling-up is more than that obtained from hybridization. (Mertz-PTT)

HYBRID DESALTING SYSTEMS.

Bechtel Group, Inc., San Francisco, CA. L. Awerbuch, S. May, R. Soo-Hoo, and V. Van Der Mast.

Desalination DSLNAH, Vol. 76, No. 1-3, p 189-197, November 1989. 5 fig.

Descriptors: *Desalination plants, *Electric power production, *Multistage flash distillation, *Power-plants, *Reverse osmosis, *Water treatment facilities, Cost analysis, Drinking water, Temperature control, Water treatment.

Currently, most large-scale seawater desalting complexes are dual-purpose multistage flash plants producing both power and desalinated water. These plants produce high purity distilled water and also provide excess electrical power for sale at a typical ratio of 10 megawat power per 1 million gallon per day of water. In the hybrid multistage flash/reverse osmosis desalination power process, a seawater reverse osmosis plant is combined with either a new or existing dual purpose multistage

flash/power plant with the following advantages: The capital cost of the combined reverse osmosismultistage flash plant can be reduced. A common, considerably smaller seawater intake can be used, in view of the smaller feedwater requirements of reverse cosmosis plants. Product water from the reverse osmosis and multistage flash plants are blended to obtain suitable product water quality. Taking advantage of the fact that the multistage flash product typically exceeds potable water specifications, the product water specification in the reverse osmosis system can thereby be reduced. A single stage reverse cosmosis process can be used and the reverse osmosis membrane life can be extended because of the reduced product water specification. Electric power production from the multistage flash plant can be efficiently utilized in the reverse osmosis plant, thereby reducing net export power production. By blending with reverse osmosis product water, the temperature of the multistage flash product water, the temperature of the multistage flash product water is reduced. (Author's abstract) W90-06569

COSTS OF SEAWATER DESALINATION IN REAL TERMS, 1979 THROUGH 1989, AND PROJECTIONS FOR 1999.

Leitner and Associates, Inc., Elm Grove, WI. G. F. Leitner.

Desalination DSLNAH, Vol. 76, No. 1-3, p 201-213, November 1989. 6 tab, 7 ref.

Descriptors: *Cost analysis, *Cost-benefit analysis, *Desalination, *Desalination plants, *Multieffect distillation, *Multistage flash distillation, *Reverse osmosis, *Seawater, *Water treatment, Capital costs, Fuel costs, Membranes, Operating costs, Projections, Water treatment facilities.

A very adequate inventory of desalting plants in operation around the world has been available for many years, but there is no compilation of capital and operating costs for these plants. Yet for any agency or municipality considering desalination, such cost data is vital to making a decision on whether or not to build the plant and what process to employ. Capital costs for reverse osmosis continue to demonstrate the most favorable and lowest cost, with multistage flash the highest, and the multiple effect distillation process in between. On the basis of world fuel cost, the reverse osmosis process would save over 10% as compared with multistage flash. As we look toward 1999, favorable experience with the multistage flash plants will be a factor in selection of future plants. However, the lower capital and operating costs for the reverse osmosis process should receive increasing attention in the coming years. The future brings a notable increase in membrane life and a good potential for reducing costs with membranes that operate at higher pressures. And for those cases where a dual purpose plant is called for, a hybrid plant will demand attention, but instead of automatic selection of the multistage flash process, the cost figures suggest a careful look at the multiple effect distillation process. (Mertz-PTT)

COMPREHENSIVE STUDY ON CAPITAL AND OPERATIONAL EXPENDITURES FOR DIFFERENT TYPES OF SEAWATER DESALTING PLANTS (RO, MVC, ME, ME-TVC, MSF) RATED BETWEEN 200 CUBIC M/D AND 3000 CUBIC M/D.

CUBIC M/Di, TRACTEBEL S.A., Brussels (Belgium). G. Fosselard, and K. Wangnick. Desalination DSLNAH, Vol. 76, No. 1-3, p 215-240, November 1989. 17 fig, 2 ref.

Descriptors: "Capital costs, "Cost analysis, "Desalination plants, "Multieffect distillation, "Multistage flash distillation, "Operating costs, "Reverse cosmosis, "Seawater, "Vapor compression distillation, "Water treatment facilities, Desalination apparatus, Drinking water, Fuel costs, Water treatment.

For planning purposes, the purchasers and their consultants, operators and salesmen often need prices for the desalination plants that must be

collected together at great efforts. Usually, previous tenders are used and these do not satisfy the expectations with respect to the process, the size and/or the situation for the specified application. This study calculates the capital and operating costs of seawater desalting plants. The costs of seawater intake and outfall, seawater pretreatment, power supply, type of desalting plants. The costs of seawater that the cost for reverse osmosis, multisage flash, multieffect, multieffect evaporation with thermal vapor compression, and mechanical vapor compression plants are calculated along with the process-related and equipment-related expenditures. Multisage flash plants are not competitive in the selected performance range. Whether reverse osmosis plants or thermic plants yield the lowest water prices depends on how the prices for electric power and heavy fuel are set. These factors point to the need for carrying out detailed calculations for each case. (Mertz-PTT)

PARAMETRIC COST ANALYSIS STUDY OF SEAWATER REVERSE OSMOSIS SYSTEMS DESIGN IN KUWAIT.

Kuwait Water Resources Development Centre, Safat.

A. A. J. Al-Zubaidi.

A. A. J. Al-Zubaidi.

Desalination DSLNAH, Vol. 76, No. 1-3, p 241-280, November 1989. 15 fig, 4 tab, 22 ref.

Descriptors: *Cost analysis, *Desalination, *Kuwait, *Reverse osmosis, *Seawater, Capital costs, Design criteria, Membranes, Operating costs, Pretreatment of water, Sensitivity analysis, Water production, Water treatment, Water treatment facilities.

Parameters affecting process design of seawater reverse osmosis are varied. Examination of these parameters is carried out under seawater conditions prevailing in Kuwait. The main parameters studied include plant production capacity, water recoveries and feed and product quality. Sensitivity analysis with respect to plant economic life, interest rate, energy prices and membrane replacement rate has led to the following conclusions: To ensure reliable and efficient plant design it is important that actual membrane productivity accounts for all pertinent data characteristic of seawater feed. Plant design must allow maintenance of rated productivity under both extreme summer and winter conditions for the duration of the membrane life. Particular attention must be paid to the design of the pretreatment section. The estimated total energy consumption is higher than expected. High overall recovery was considered as unsound engineering practice, as it violates the 90% design rule during summer condition. The parametric cost functions accurately predict the plant capital investment costs. Water unit cost decreases with increasing plant overall recovery. And finally, the most dominant water unit cost components are energy, membrane replacement and capital charges. (Mertz-PTT)

TECHNICAL AND ECONOMICAL COMPARISON BETWEEN LARGE CAPACITY MSF AND RO DESALTING PLANTS.

Kuwait Univ., Safat. Dept. of Mechanical Engineering.

M. A. Darwish, M. Abdel Jawad, and G. S. Alv.

M. A. Darwish, M. Abdel Jawad, and G. S. Aly. Desalination DSLNAH, Vol. 76, No. 1-3, p 281-304, November 1989. 4 tab, 4 fig, 9 ref.

Descriptors: *Cost analysis, *Desalination plants, *Multistage flash distillation, *Reverse osmosis, Comparison studies, Energy costs, Membranes, Water treatment, Water treatment facilities.

In the course of evaluating the unit cost of desalted water by either the predominant multistage flash, and its competitor reverse osmosis desalting systems, a quantitative comparison between the equipment was conducted. The chemical and energy consumptions were also compared for both systems. The study indicated that more extensive ma-

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terials and more energy were consumed in the emultistage flash desalting system, as compared to the reverse osmosis system. Consequently, the unit cost of desalted seawater by reverse osmosis system was lower than that obtained by the multistage flash system. Moreover, prospects for lower tage thash system. Moreover, prospects for lower cost by the reverse osmosis system exist by developing more efficient energy recovery systems, and reducing the cost of the membrane. It is believed that the present membrane cost is much higher than real manufacturing cost. (Author's abstract) W90-06573

TECHNICAL ASPECTS OF REDUCING DE-SALTING WATER COST BY DISTILLATION METHODS.

Kuwait Univ., Safat, Dept. of Mechanical Engi-

M. A. Darwish, and M. Abdel-Jawad. Desalination DSLNAH, Vol. 76, No. 1-3, p 305-322, November 1989. 7 fig, 2 tab, 3 ref.

Descriptors: *Cost analysis, *Desalination, *De-salination plants, *Kuwait, *Multieffect distillation, *Multistage flash distillation, *Vapor compression distillation, *Water costs, *Water treatment, Elec-tric power production, Powerplants, Steam tur-bines, Water treatment facilities.

In Kuwait, the installed capacity of desalting plants is continuously increasing (from 1 million gallons/day in 1953 to 263 million gallons/day in 1989) as well as the water consumption per capita (from 57 L/day in the late 1950s to 272 L/day in the mid-1980s). Any decrease in the desalted water unit cost means substantial savings to Kuwait due to the bureamounts of desalted vater production. to the huge amounts of desalted water production.

Prospects of the present and near future improve-Prospects of the present and near future improvements in desalination technologies by distillation processes that may affect the desalted water unit cost include capital and running costs of the main distillation systems such as multistage flash, multieffect boiling, and vapor compression systems. Design and operating parameters that have impact on the cost include maximum brine temperatures, type of water treatment, number of stages or effects, means of supplying energy, and material selection. Through examination of technical factors affecting the cost of desalting water it was shown that conventional multieffect system can produce desalted water with lower cost than multistage flash systems when both are supplied with steam after its expansion in steam turbines. Mechanical or thermal vapor compression desalting systems are more cost effective when compared with directly operated multistage flash systems. with directly operated multistage flash systems. (Mertz-PTT) W90-06574

PROCESS ARRANGEMENTS FOR HYBRID SEA WATER DESALINATION PLANTS.
I. Kamal, W. Schneider, and G. F. Tusel. Desalination DSLNAH, Vol. 76, No. 1-3, p 323-335, November 1989. 6 fig, 2 tab, 2 ref.

Descriptors: *Desalination, *Desalination plants, *Electrical power production, *Multistage flash distillation, *Reverse osmosis, *Scaling, Cost anal-ysis, Seawater, Vapor compression distillation, Water treatment, Water treatment facilities.

In thermal seawater desalination the usual process In thermal seawater desalination the usual process arrangement, with a few exceptions, consists of the multistage flash process based on the brine recycle principle. This principle has held its ground for the last 30 years because of the lack of a suitable cost-effective additive for the prevention of scale. With the development of anti-scalants requiring low dosing rates for the once-through multistage flash process, the incentive for the brine recycle scheme has disappeared, and there is no longer any justification for its continued usage. The once-through process can produce water more economically than the brine recycle process, especially in the Gulf and Red Sea areas where seawater concentrations are high. In other areas it may be possible to Ouir and Ked Sea areas winer seawater concentra-tions are high. In other areas it may be possible to use the blowdown from a once-through multistage flash plant as feed for a reverse osmosis unit, and to use the reject from the reverse osmosis unit after power recovery as feed for a vapor compression evaporator-concentrator, greatly increasing the

process efficiency and overall product recovery. (Mertz-PTT) W90-06575

PRODUCTION AND COST FUNCTIONS OF WATER LOW-TEMPERATURE SOLAR DESALINATION,

Patras Univ. (Greece). Dept. of Mechanical Engi-

neering. N. G. Zagouras, Y. G. Caouris, and E. T. Kantsos. Applied Economics APPEBP, Vol. 21, No. 9, p 1177-1189, September 1989. 5 fig, 3 tab, 10 ref.

Descriptors: *Water treatment, *Cost analysis, *Solar distillation, *Desalination, Engineering, Water temperature, Economic aspects.

A case study of operation of desalination plants illustrates the possibility of obtaining appropriate economic production function and cost function illustrates the possibility of obtaining appropriate economic production function and cost function from a computational engineering model by varying a determining parameter and observing the values of all technical aprameters and the associated costs. The model was developed in order to investigate the technical and cost parameters of low-temperature solar desalination plants. The underlying economic production functions are of the Cobb-Douglas form. In the first approach, the desalination plant was considered to operate under maximum load continuously through the year, except for necessary maintenance periods. In the second approach, the desalination plant was considered to operate under different partial load over the year. It is important to note that the marginal cost of the desalination was much lower than the average total cost. In other words, if the duration of operation of a desalination plant devoted to cover peak demands is somewhat extended for other uses, then the additional cost per additional desalted water unit is much lower than the minimum average total cost. It would be very interesting to examine the opportunity of using this additional water in some agricultural activities, particularly those producing high-valued products. The question arises whether it is advantageous to extend the operation of the 'peak-summer' plants in order to cover irrigation needs in autumn and spring, for some early or late cultivations in arid but fertile and wind-protected zones. The answer must be given on the basis of the marginal cost only. (Author's abstract)

INCREASING DEMAND FOR DESALINA-

Kuwait Fund for Arab Economic Developme

T. A. Dabbagh, and A. Al-Saqabi. Desalination DSLNAH, Vol. 3, No. 1/3, p 3-26, November 1989. 3 fig, 3 tab, 22 ref.

Descriptors: *Arid zone, *Desalination, *Semiarid lands, *Water demand, Costs, Economic aspects, Research priorities, Wastewater renovation, Water conservation, Water reuse, Water supply.

In reviewing the alternative water resources available in arid and semi-arid zone countries when appraising water sectors for providing aid for de velopment, it becomes increasingly evident that appraising water sectors for providing aid for development, it becomes increasingly evident that there will be a greater demand for desalination by the turn of the century. The cost of producing water in developing countries it is noted that when it comes to providing water the price will be paid, however high it may be. Reducing the cost of desalinated water, however, is not only dependent on improving desalination technology, but also on improving the management of the conservation and utilization of desalinated water. It is emphasized that when desalination is proposed it is imsized that when desalination is proposed it is im-portant that it should be carried out in conjunction with improving the efficiency of the water supply system, reusing sewage effluent and substantially increasing storage capacity. Areas where further research is required include construction materials. process chemicals, alternative energy, and the use and/or extraction of minerals from brine. There is a need for collaborative action by arid zone oilproducing countries in setting up an institutional framework that would enable their extensive experience with desalination to be shared, and permit rience with desalination to be shared, and perr

the establishment of a body of expertise that could work toward reducing the present, often prohibi-tive, cost of desalination. (Author's abstract) W90-07431

MANAGEMENT AND FEASIBILITY OF RE-VERSE OSMOSIS SCHEMES FOR RURAL WATER SUPPLY IN INDIA.

Bhabba Atomic Research Centre, Bombay (India). Desalination Div.

S. Prabhakar, R. N. Patra, B. M. Misra, and M. P.

Desalination DSLNAH, Vol. 3, No. 1/3, p 37-46, November 1989. 1 fig, 1 tab, 2 ref.

Descriptors: *Desalination, *Developing countries, *India, *Reverse osmosis, *Rural areas, *Water management, *Water supply, Economic aspects, Personnel, Saline water, Site selection, Social aspects, Total dissolved solids, Water resources development.

The adoption of the reverse osmosis process as a desalination system for meeting the demand for fresh water in rural India has been critically examined with respect to the technical, economic, social ined with respect to the technical, economic, social and logistic aspects. The introduction of new technology in the country poses many problems, specifically those related to the capability of manufacturing and operating personnel. The performance of two 10 cu m/8 hr demonstration reverse osmosis (RO) plants installed and maintained in remote villages, has provided, beside data, experience for the analysis of such problems. Optimum capacities and specifications for the reverse osmosis systems have been developed taking into account competiveness with conventional water supply systems. Based on the experience of operating these RO plants in remote villages, the salient features of such plants are: (1) the selection of sites, for installation of RO plants in the villages was based primarily on the availability of power; (2) the low lation of RO plants in the villages was based primarily on the availability of power; (2) the low yield of raw water is a major constraint in achieving a desired plant capacity; (3) due to the scattered location of villages, their relatively small population and uncertainty in adequate yield of brackish water, large capacity RO plants could not be considered even though there are definite cost advantages; (4) from the viewpoint of amploament advantages; (4) from the viewpoint of employment of local people in the RO plants, utilizing semiskilled persons from the same village seems to be the obvious choice; and (5) the acceptance of prod-uct water from RO plants as a drinking water uct water from RO plants as a drinking water source for the village requires educating the inhabitants. The role of voluntary agencies in this matter is significant. The typical cost figures for the RO plants containing up to 10,000 parts per million (ppm) total dissolved solids ranges from \$50,000 for 10 cu m/day to about \$200,000 for 100 cu m/day capacity plants. (Lantz-PTT) W90-07433

WATER SUPPLY AND DESALINATION IN NORTHWESTERN EGYPT.

CH2M Hill International Corp., Gainesville, FL. O. K. Buros, and S. Yacoub. Desalination DSLNAH, Vol. 3, No. 1/3, p 47-59,

November 1989. 1 fig, 3 tab, 1 ref.

Descriptors: *Desalination, *Egypt, *Rural areas, *Water supply, Brackish water, Developing countries, El Nasr Canal, Filtration, Marsa Matrouch, Water demand, Water treatment.

The Matrouh Governorate located in northwest-ern Egypt has experienced considerable growth lover the past decade as more people use the fine beach areas along the Mediterranean coast. The area is one of low rainfall and this growth has strained the existing sources of water. Traditionally, water has been supplied to the Governorate by low-yield wells, rain water collection, seawater desalination, and Nile water delivered by train, desalination, and Nile water delivered by train, truck, and pipeline. For many years there has been interest in expanding the existing seawater desali-nation facility in Marsa Matrouh to provide a reliable supply of water for the city. In 1987-88, the US Agency for International Development (USAID) helped to provide a number of small brackish water desalting plants to be used in the

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A-Saline Water Conversion

rural areas. In 1988, USAID selected a private firm to collect drta on water usage, land use, and population in the Governorate. The study indicated that the overall potable water consumption in the City of Marsa Matrouh can be estimated as about 42 L/capita/day in the winter and 36 L/capita/day in the summer. These rather low consumption rates reflect the shortage of readily available water, high water cost, and the low incidence of water consuming appliances. During February 1988, only 13% of the water pumped to El Alamein reached the City of Marsa Matrouh, indicating that the pipeline is leaking and other losses of water are occurring. The area west of Marsa Matrouh also has water problems. During 1987-88 USAID, installed brackish water desalination units in six locations in this area in an effort to ease the persistent potable water shortages. The capacity is nominal only, since the units generally run about 4 hr/day in the winter and 10 hr/day in the summer. Following a review of several alternatives, the alternative recommended for Marsa Matrouh was the construction of a new coagulation filtration water reatment plant on the El Nasr Canal. This plant would be dedicated solely to the water needs of the Matrouh Governorate. The water from this plant would be transferred by pipeline to the existing 700 mm pipeline at a point near El Hamman. From there, the water would be pumped westward to serve the demand along the coast and end at the City of Marsa Matrouh once the 700 mm pipeline is completed. (Lantz-PTT)

FEASIBILITY OF SEAWATER DESALINATION TO SOLVE WATER SHORTAGE PROBLEMS OF THE SALINA CRUZ (PEMEX) RESTINERY.

C. A. Fernandez, B. H. Huerta, and F. E. Latapi. Desalination DSLNAH, Vol. 3, No. 1/3, p 61-77, November 1989. 4 fig, 3 tab.

Descriptors: *Desalination, *Industrial water, *Mexico, *Oil industry, *Seawater, *Water supply, Distillation, Saline water.

As a part of Mexico's Pacific Coastline Project, the Salina Cruz Refinery with an actual capacity of 165,000 billion barrels/day (bbd) is being expanded to 330,000 bbd (crude oil). The local water shortage problem has led to the consideration of seawater desalination as a source of fresh water for the refinery and other community and industrial uses. Through the use of desalination, the refinery will become independent from its present fresh water source. This will in turn, help to mitigate some regional political and social demands being placed on the refinery and its excessive use of the local fresh water supply. Based on capacity requirements, process reliability and national integration, the desalination process selected is multi-stage flash distillation. (Lantz-PTT)

DELBUOY: OCEAN WAVE-POWERED SEA-WATER REVERSE OSMOSIS DESALINATION SYSTEM.

ISTI Delaware, Inc., Lewes.
D. C. Hicks, C. M. Pleass, G. R. Mitcheson, and J. F. Salevan.

Desalination DSLNAH, Vol. 3, No. 1/3, p 81-94, November 1989. 6 fig, 1 tab, 17 ref.

Descriptors: *Desalination plants, *Ocean waves, *Reverse osmosis, Economic aspects, Potable water, Saline water, Saline water, Tropical areas, Water supply, Water treatment.

Most ocean wave energy conversion systems have been designed as large-scale electricity producers. Such devices require the solution of serious storage, phasing, and distribution problems, and usually must be on a large sale for satisfactory economic results. Alternatively, an ocean wave energy system, under development since 1976, directly links ocean wave power with the production of fresh water from seawater using reverse osmosis (RO) technology. The device, referred to as DELBUOY, utilizes no motors, generators or electronics and makes extensive use of engineering polymers for constructing major system components.

The DELBUOY combines a wave driven buoy, linear pump and an anchor system with well-proven single-pass seawater RO membranes to produce potable water. The systems are modular in nature, allowing arrays to be sized to suit specific site requirements, from as little as 6 cu m/day. Unlike many of the other wave energy devices currently under development, the DELBUOY is an economic alternative to conventional desalination systems in wave fields as small as one meter. The DELBUOY system is especially useful in areas that are remote, have insufficient or unreliable power supplies or have high power costs. It was specifically designed for service in tropical areas within the steady Trade Wind wave field. The research and development of the device encompassed wave tank testing, mathematical modeling, materials testing and system sea trials. Commercial production of the DELBUOY was started in 1985. Since that time, the system has undergone production engineering, supported by five full-scale sea trials and commercial installations. Operating experience obtained to date indicate that with only a five year amortization period, the DELBUOY system is an economic alternative to conventionally powered desalination system in areas where power costs are high. (Author's abstract) W90-07436

DEVELOPMENT, TESTING AND THE ECONOMICS OF A COMPOSITE/PLASTIC SEAWATER REVERSE OSMOSIS PUMP.

ISTI Delaware, Inc., Lewes.
D. C. Hicks, C. M. Pleass, W. A. Fearn, and D. Staples.

Staples.
Desalination DSLNAH, Vol. 3, No. 1/3, p 95-109, November 1989. 6 fig, 16 ref.

Descriptors: *Desalination, *Economic aspects, *Polymers, *Pumps, *Reverse osmosis, *Seawater, Hydraulic equipment, Maintenance, Performance evaluation, Saline water.

Plastics, polymers and composites are increasingly found to be cost effective alternatives to metallic components in a wide range of applications. The reverse osmosis (RO) desalination industry is an example where plastics, because of their inertness in saline waters and the ease with which they can be fabricated, have received wide acceptance for use in low pressure applications. However, polymeric materials have not been used extensively in high pressure RO components other than in the membrane housing. Responding to the demand for a noncorrodable, low maintenance seawater RO pump, a line of seawater lubricated, axial piston pumps constructed almost entirely from polymers and composites has been designed and tested. The pump, referred to as the DELPUMP, utilizes the seawater being pumped to cool and lubricate all bearings and to refill the cylinders. As a result, maintenance requirements and risks of contamination have been eliminated. A further benefit components in electrical contact is that the problem of electrolysis has been eliminated. Endurance tests verify that DELPUMP units will operate for 8000 hours between maintenance intervals. Maintenance will require only common tools and easily learned techniques to replace a few inexpensive component parts. (Lantz-PTT)

DEVELOPMENT AND APPLICATION OF A ROOF TYPE SOLAR STILL. Nagoya Univ. (Japan). Dept. of Chemical Engi-

Nagoya Univ. (Japan). Dept. of Chemical Engineering. K. Murase, S. Kobayashi, M. Nakamura, and S.

Desalination DSLNAH, Vol. 3, No. 1/3, p 111-118, November 1989. 5 fig, 5 ref.

Descriptors: *Desalination, *Distillation, *Solar energy, *Solar stills, Performance evaluation, Stills.

An improvement to the feeding system of a roof type solar still was tested. The still is composed of bent heat penetrating plates with a channel at the center for liquid flow below the bending crease. A

laboratory test apparatus was constructed having a 500 x 500 mm heat penetrating area designed and made mainly from polyethylene film. The upper surface was illuminated by infrared lamps with an intensity range between 240 and 650 Watts/cu m. The test apparatus did produce fresh water from salt water. A panel of photoelectric cells was substituted for the heat receiving plate of the solar still. This hybrid system of the roof type solar still, combined with photo cell power generation was simulated, and the computed result revealed that the water to power ratio is on the order of 5 cu m/kWh, several hundred times that of conventional dual purpose systems. It can be concluded that the tested roof type solar still and the proposed hybrid system is quite promising and worthy of further development. (Lantz-PTT)

CARRIER-GAS PROCESS-A NEW DESALINA-TION AND CONCENTRATION TECHNOLO-

EvCon Corp., Minneapolis, MN. R. Larson, W. Albers, J. Beckman, and S.

Desalination DSLNAH, Vol. 3, No. 1/3, p 119-137, November 1989. 6 fig, 2 tab, 5 ref.

Descriptors: *Carrier gas process, *Desalination, *Wastewater treatment, *Water treatment, Brackish water, Economic aspects, Equipment, Evaporation, Seawater, Water treatment facilities.

The Carrier-Gas Process (CGP) has demonstrated excellent potential for desalination of seawater and brackish water and for concentration of various process streams and industrial wastewaters. The CGP uses air at atmospheric pressure as a carrier gas to evaporate water upon heating and then to condense pure water upon cooling in such a manner as to reuse the energy of evaporation many times. Owing to use of below boiling temperatures and ambient pressure, the process device is of simple construction and may be made entirely of inexpensive plastics. Large-scale CGP plants are projected to have significant capital cost and operating cost advantages over reverse osmosis and conventional distillation systems. (Author's abstract)

PROSPECTIVE OF TWO SMALL WATER PRODUCING UNITS.

King Abdulaziz Univ., Jeddah (Saudi Arabia). Coll. of Engineering. A. A. Madani, and G. M. Zaki.

A. A. Madani, and G. M. Zaki. Desalination DSLNAH, Vol. 3, No. 1/3, p 167-180, November 1989. 6 fig, 2 tab, 6 ref.

Descriptors: *Condensation, *Desalination plants, *Developing countries, *Distillation, *Rural areas, *Solar stills, Brines, Costs, Humidity, Water vapor.

The potential of two methods, air dehumidification and solar distillation for water desalination of small capacities, 50 cu m/day, was investigated. A test rig for the first method has been operated for dehumidifying saturated air at flow rates up to 0.555 kg/sec. An average enthalpy based overall heat transfer coefficient of 172 W/sq m-kJ/kg was measured in the dehumidifier condenser. The yield of the unit varies between 630 ml/h to 1250 ml/h. Prototype solar stills have been operated to give an average yield within 2.8 to 3.42 I/sq m/day. The symmetrical still orientation and the brine level variation (5-7 cm) did not significantly effect the yield. For actual units of 50 cu m/day, the production cost varies from \$3.1 to \$7.2 /cu m. (Author's abstract)

EVALUATION OF SOLAR POWERED DE-SALINATION PROCESSES.

King Abdulaziz Univ., Jeddah (Saudi Arabia).
Dept. of Chemical Engineering.
I. S. Al-Mutaz, and M. I. Al-Ahmed.

I. S. Al-Mutaz, and M. I. Al-Ahmed. Desalination DSLNAH, Vol. 3, No. 1/3, p 181-190, November 1989. 1 fig, 6 tab, 6 ref.

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

Saline Water Conversion—Group 3A

Descriptors: *Arid zone, *Desalination, *Performance evaluation, *Reverse osmosis, *Solar energy, Electrodialysis, Evaporation, Multistage flash evaporation, Persian Gulf, Solar stills.

Beside conventional thermal distillation processes, Beside conventional thermal distillation processes, other desalination processes have been made possible through the application of the active utilization of solar energy. These processes include electrodialysis, reverse osmosis, and freezing. Solar desalination is considered the best alternative to provide fresh water in remote arid areas. Solar desalination fresh water in remote arid areas. Solar desalination process(es) (solar stills, reverse osmosis plants operated by electricity produced by photovoltaic cells, electrodialysis operated by electricity produced by photovoltaic cells, multiple effect evaporation plants operated by steam of high temperature produced by focused collectors, and/or multistage flash plant operated by steam of high temperature produced by focused collectors) were evaluated for use in the Arabian Gulf region. The point evaluation method showed that the solar powered reverse osmosis process is the best alternowered reverse osmosis process is the powered reverse osmosis process is the best alter-native for water desalination in arid regions. Re-verse osmosis meets technical and operational verse osmosis meets technical and operational specifications that make it more appropriate than any other processe for small capacity desalination plants. Solar stills rely for complete dependability on solar energy. They are the least flexible method of solar desalination, and their costs are still high.

PERFORMANCE RATIO, AREA ECONOMY AND ECONOMIC RETURN FOR AN INTE-GRATED SOLAR ENERGY/MULTI-STAGE FLASH DESALINATION PLANT.

Panjab Univ., Chandigarh (India). Dept. of Chemi-

Panjao Umiv., Chandigain (India). Dept. of Chandical Engineering.
D. Singh, and S. K. Sharma.
Desalination DSLNAH, Vol. 3, No. 1/3, p 191-195, November 1989. 3 fig, 5 ref.

Descriptors: *Desalination plants, *Economic aspects, *Multistage flash evaporation, *Solar energy, Developing countries, Distillation, India, Performance evaluation, Solar stills.

Solar energy for desalination may be used in a variety of ways—the commonest technique being solar stills. An alternative approach involves the integration of a solar energy collection system with a conventional multistage flash (MSF) evaporation unit. The performance ratio and area economy of such a unit was investigated for a variety of process conditions. Based on conservation assumptions ess conditions. Based on conservation assumptions with respect to collection efficiency and average insolation, the area economy (the output/unit collector area) varied between 7-20 for various levels of recovery compared to only 2.1 for a solar still. For the same conditions the performance ratio of an integrated unit is 3-10 times higher than that of a solar still. (Lantz-PTT) W90-07443

SOLAR DESALINATION WITH A HIGH EFFI-CIENCY MULTI EFFECT PROCESS OFFERS NEW FACILITIES.

AQUASOLAR G.m.b.H. and Co. K.G., Laatzen (Germany, F.R.).

A. Bohner.
Desalination DSLNAH, Vol. 3, No. 1/3, p 197-203, November 1989. 4 fig, 3 ref.

Descriptors: *Desalination plants, *Solar energy, *Water treatment facilities, Agricultural water, Condensation, Distillation, Evaporation, Potable water, Temperature, Water supply.

A new solar powered desalination process named SMCE cycle (solar multiple condensation evaporation cycle) belongs to the category of humid aid distillation processes. The 'multi effect' refers to the number of condensation-evaporation effects which are achieved through a certain energy input. which are achieved intrough a certain energy input. The process works with ambient pressure in contrast to multi-stage flash plants. The solar desalination plant consists of the following parts: the evaporation tower, condenser, flat-plate collector field and heat storage. The evaporation tower produces the water vapor rich air, which flows by natural

convection to the condenser. The condenser is cooled by sea water or brackish water and reduces the temperature of the humid air. This results in a condensation of water vapor, and the cold water, the temperature of the humid air. This results in a condensation of water vapor, and the cold water, which flows through the condenser, absorbs the condensation heat. This process of heat recovery reduces the thermal energy consumption up to 2 or 3 times. The overlapped temperature ranges of the evaporation process are 75 C to 35 C, and of the condensation process 25 C to 55 C. The salt water in the condenser is heated to about 55 C and then repeated in the solar panel to a temperature of reheated in the solar panel to a temperature of approximately 75 C. This warm salt water can be used repeatedly for the evaporation process in the evaporation chamber. Two types of systems are possible, one with a closed air cycle and one with a closed water cycle. The 100% solar powered plant closed water cycle. The 100% solar powered plant and the content of 200 contents are of 200 contents. closed water cycle. The 100% solar powered plant operates decentrally in a water capacity range of 2 to 20 cu m/day. The high quality distillate water can be used as potable water or for agricultural applications. The plant operates within a solar energy efficient low temperature range of 65 to 75 C. Except for a feed water pump, the plant uses no high tech parts making this desalination concept very adaptable. (Lantz-PTT)

STUDY OF THE OPERATING CONDITIONS FOR THREE LARGE MSF DESALINATION UNITS EACH OF CAPACITY 7.2/8.6 MGD (27360/32832 TON/DAY) IN ABU DHABI, UAE. El Saie (M.H.A.), Cairo (Egypt).

M. H. A. El Saie, M. S. El Kafrawi, and M. I.

Desalination DSLNAH, Vol. 3, No. 1/3, p 4 fig, 5 ref, November 1989. 4 fig, 5 ref.

Descriptors: *Desalination plants, *Distillation, *Multistage flash evaporation, *Performance eval-uation, Abu Dhabi, Arid zone, Energy, Power-plants, Water supply.

Operating conditions of three multistage flash (MSF) desalination units with a water production capacity of 7.2/8.6 million gallons per day (MGD) each were studied. These units form an integral each were studied. These units form an integral part of a dual system combined cycle electric power and desalination plant. The plant comprises two gas turbines, two exhaust heat recovery boilers with two auxiliary boilers, and three desalination units of 7.2/8.6 MGD each with low/high temperature additives respectively. The design patemperature additives respectively. The design parameters, commissioning results and plant operating conditions were examined after one and two years of continuous operation. The distillate production of the plant is still higher than the design feature by 2.3% after running hours and 3% after 15,000 running hours, despite the fact that the flash range is smaller than the design range. The steam usage is less than the design figure by 1.96% after running hours and higher by 1.96% for distillate production of 3% higher than the design figures after 15,000 running hours. The performance ratio is higher than the design figure by 3.8% after 7,000 running and by 0.65% after 15,000 running hours. Thorough specification during tender stage and running and by 0.65% after 13,000 running hours. Thorough specification during tender stage and proper follow up and analogy to similar plants during final design stages are the main goal to ensure a successful plant both during commissioning and long period operation, without losses in production and efficiency and with maximum reliability. (Lantz-PTT)
W90-07445

METHOD FOR EXTENDING HEAT EXCHANGER AND CONDENSER LIFE. CTI International, Southport, CT.

Desalination DSLNAH, Vol. 3, No. 1/3, p 231-246, November 1989. 1 tab, 7 ref, append.

Descriptors: *Condensers, *Desalination appara-tus, *Heat exchangers, *Maintenance, Copper, Corrosion, Costs, Distillation, Economic aspects,

More than 85% of copper alloy heat exchanger and condenser tube problems are caused by erosion/corrosion which occurs within 6 inches of the tube inlets. An accelerated worldwide search has now resulted in a positive guaranteed technique for the restoration of these damaged tubes suffering inlet and erosion/corrosion without resorting to high cost full retubing. With the development of alloys extremely resistant to erosion/corrosion it alloys extremely resistant to erosion/corosion it has become possible to use super thin-walled inserts which, when properly manufactured and installed, will fully protect tube inlets for as long as fifteen years. In addition they will: (1) restore tube to tube hole integrity; (2) restore already plugged leaking tubes to active circulation; (3) permit mechanical tube cleaning; and (4) cost 20-25% of full retubing. Following process measurements and full retubing. Following precise measurements and fab-rication, each insert is expanded hydraulically through its full length into the tube inlet to pre-set tightness. As a result the sleeve and the tube become monolithic. The tube inlets are thereby restored to their original leak-free design strength at a fraction of the cost of full retubing. This restoration technique has proven successful in more than 3,000,000 tubes in condenser and heat exchangers in electric utilities, refineries and marine plants throughout the world. (Author's abstract) W90-07446

REVIEW OF LARGE DESALINATION PLANT EXPERIENCE IN THE AMERICAS.

Ahlgren Associates, Waukasha, WI. R. M. Ahlgren, and I. Smith.

Desalination DSLNAH, Vol. 3, No. 1/3, p 247-

Descriptors: *Desalination plants, *Performance evaluation, *Water treatment facilities, Chemical interactions, Copper, Corrosion, Hydrogen ion concentration, Maintenance, Oxygen, Saline water.

The American Hemisphere is generally considered to be rich in fresh water resources in most areas. However, since the late 1950's, almost 100 desalination plants were installed in the Americas, operday. This number does not include installations using multiples of smaller sized plants but produccay. In a number does not include installations using multiples of smaller sized plants but producing a total volume of water exceeding this figure. Of the almost 100 plants installed in this hemisphere over the last three decades, only about 1/3rd are presently in service. Of the approximately 30 major desalination systems operating in the Americas, the majority are < 10 years old only 5 of the plants presently in service are more than 10 years old and only two of these have been operating for > 20 years. A reivew of background information, and discussion with individuals involved with shut-down plants revealed at least two consistent and significant factors. First is that chemical control of the plants was generally acknowledged to be difficult and/or inconsistent. Review of some of the operating records and inspection reports relevant to these plants seems to indicate that the pH of the recirculating brine frequently varied across ranges from 4 to 9 making indicate that the pH of the recurculating office frequently varied across ranges from 4 to 9 making it almost impossible to form and maintain any protective oxide film on either ferrous or copper alloy material surfaces. Second by the plants were frequently out of service for internal adjustments or repairs. Frequent cycling of desalination equipment and exposure of shell steel to atmospheric ment and exposure of shell steel to atmospheric oxygen were devastating to corrosion resistance. Times of over acidification or low pH usually resulted in extreme thinning of copper alloy tubes and excessive oxygen resulted in deterioration of shell steel. (Lantz-PTT)

EXPERIENCES WITH A HIGHLY ALLOYED STAINLESS STEEL IN DESALINATION PLANTS AND OTHER ARABIAN GULF INDUSTRIAL PLANTS.

Avesta Jernverk A.B. (Sweden). J. Olsson, and M. L. Erbing. Desalination DSLNAH, Vol. 3, No. 1/3, p 267-275, November 1989. 3 fig, 13 ref.

Descriptors: *Desalination apparatus, *Materials testing, *Stainless steel, *Water treatment facilities, Arabian Gulf, Arid zone, Condensers, Multistage flash evaporation, Pipes, Reverse osmosis, Sea-

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A-Saline Water Conversion

Experiences from the installation of highly alloyed stainless steel UNS S31254 in desalination plants, multistage flash (MSF) evaporation and reverse multistage flash (MSF) evaporation and reverse cosmosis (RO), and other industrial plants in the Arabian Gulf countries are reported. More than seven years of successful operation has shown that this material resists corrosion in seawater handling systems such as high pressure piping in RO-plants, ejector condensers in MSF-plants, and cooling water piping in other industrial plants. The higher strength of UNS S31254 in comparison to AISI 316L enables a considerable reduction in wall bickness of high pressure piping in RO-plants. thickness of high pressure piping in RO-plants. (Author's abstract)

REHABILITATION OF DESALINATION PLANTS AT SITRA POWER STATION, BAH-RAIN.

RAIN.
Ministry of Public Works, Power and Water,
Manama (Bahrain). Electricity Directorate.
K. Borashid, and K. Kato.
Desalination DSLNAH, Vol. 3, No. 1/3, p 277293, November 1989. 1 fig, 2 tab, 2 ref.

Descriptors: *Desalination plants, *Maintenance, *Sitra Power Station, Bahrain, Corrosion, Economic aspects, Equipment, Water treatment facili-

The first two multistage flash (MSF) plants (11,500 cu m/day each) at Sitra Power Station, Bahrain have been in commercial operation since 1976. The units have had a history of severe corrosion probunits have had a history of severe corrosion prob-lems in the vapor spaces since the early years of commissioning. Extensive studies followed by vari-ous trial modifications were made on one unit in 1984 and 1985, with the objective of finding the most cost effective measures for rehabilitation to ensure an operational capability to the end of the designed commercial life or beyond. A rehabilita-tion program, was established in 1986 and the most designed commercial life or beyond. A rehabilitation program was established in 1986 and the mechanical rehabilitation works were successfully
completed on both units by July 1987, and the
warranty condition confirmed. Internal painting
and a stainless steel lining have been shown to be
practical and effective methods to stop corrosion
of the old carbon steel evaporators, provided that
there is sufficient access to the corroded area to
carry out the repair work. With the implementation of the rehabilitation works on units IA and
IB, the following achievements were made: (1)
stable operation with good performance; (2) annual
maintenance in the future is expected to be limited
to small touch-up work for internal paint and to small touch-up work for internal paint and hence shorten outage period; and (3) plant useful life can be extended for 5 to 6 years. (Lantz-PTT)

RECARBONATION PROCESS FOR TREAT-MENT OF DISTILLED WATER PRODUCED BY MSF PLANTS IN KUWAIT.

Ministry of Electricity and Water, Safat (Kuwait). For primary bibliographic entry see Field 5F. W90-07450

PRACTICAL EXPERIENCE IN SCALE CON-

TRUL.

M. A. Al-Sofi, S. Khalap, and A. Al-Omran.
Desalination DSLNAH, Vol. 3, No. 1/3, p 313325, November 1989. 4 fig, 2 tab, 13 ref.

Descriptors: *Desalination, *Scaling, *Water supply, *Water treatment facilities, Distillation, Evaporation, Multistage flash evaporation, Recirculation. Temperature

Desalination is becoming a vital source of domestic water for the Arabian Peninsula. Reliance on desalination is particularly pronounced along the east coast, i.e. Gulf Coast of Saudi Arabia and other Gulf Cooperation Council (GCC) States. To date the primary process deployed along the Gulf is multistage flash (MSF) evaporation. MSF performance relies primarily on heal transfer between vapor and brine solution along a temperature range of 25-121 C. Almost all MSF evaporators in this region are operated by brine recirculation to impression are operated by brine recirculation to imregion are operated by brine recirculation to im-prove efficiency and reduce cost. Yet recirculation andates heat transfer within a concentrated sea-

water solution. Due to the concentrated nature of water solution. Due to the concentrated nature of the heat transfer medium, scaling is the most criti-cal factor controlling MSF productivity, especially at the upper half of the temperature range. Scale formation cannot be eliminated, but it can be com-bated. It is particularly essential to minimize scale normation cannot be eliminated, but it can be combated. It is particularly essential to minimize scale formation on heat transfer surfaces, i.e. tube inner surfaces. Minimum scale presence in tubes is achieved by either formation prevention or removal. Five case histories are included: Case A pertains to a medium capacity evaporator of 2-3 million gallons per day (MGD) distillate production. Case B is a special trial on ball cleaning at an optimized low antiscalant dose rate. This trial was on one of the larger capacity MSF evaporators. Trial B was performed on a 6-7 MGD evaporator, while cases C through E are on a third group of evaporators of 5-6 MGD production capacity. In this last group, the three cases are: C—an antiscalant optimization trial; D—general observations on the day-to-day optimized operation of this group of evaporators; and E—another antiscalant optimization trial. (Author's abstract)8888888

OPERATIONAL EXPERIENCE OF ONCE THROUGH MSP DESALINATION UNITS. Ministry of Electricity and Water, Safat (Kuwait). A. A. Al-Owais, and P. K. Budhiraja. Desalination DSLNAH, Vol. 3, No. 1/3, p 327-340, November 1989. 5 fig, 1 tab.

Descriptors: *Corrosion control, *Desalination plants, *Industrial water, *Maintenance, *Multistage flash evaporation, Demineralization, Design standards, Distillation, Erosion, Evaporation, Powerplants, Scaling, Steam turbines, Water treatment

The operational experience of three six-stage, once through flash-type desalination units is described. The desalination units have been installed to cater The desalination units have been installed to cater to the need for desalinated water, which is subsequently demineralized for two steam turbine units in the Emirate of Ras-Al-Khaimah, U.A.E. The study concentrates mainly on the problems faced regarding the materials of construction, the design philosophy, and modifications/augmentation carried out at site. One of the main problems faced in the evaporators, has been the continued corrosion of distillate trays which could not be attended because of the integral tube bundle design of con-densers. This continued corrosion is attributed to low product pH due to the partial presence of carbon dioxide evolved during the breakup of bi-carbonates. It was decided to change the design of condenser tube bundles so that access to distillate collection trays became possible, allowing for periodic attention. After modification of the condenser onic attention. After modification of the condenser tube bundles, the evaporators have been giving a very satisfactory performance. It was also observed that the impellers of the raw water pumps for the seawater feed, operating at 2900 rpm, suffered more erosion/corrosion when compared to the impellers of the raw water pumps operating at 1450 rpm. It is suggested that while designing pumps for handling seawater for the desalination plants, optimization should be kept in mind when plants, optimization should be kept in mind when considering operational problems, breakdowns and larger operating costs due to high speed pumps. Sharp bends and nozzles immediately after the pumps should be avoided since the excessive turbu-lence created because of these nozzles crodes the welded joint of the nozzles. (Lantz-PTT) W90-07452

BELGARD EV-15 YEARS' EXPERIENCE IN

SCALE CONTROL.
CIBA-GEIGY Plastics and Additives Co., Manchester (England). Industrial Chemicals Div.
M. A. Finan, S. Smith, C. K. Evans, and J. W.

Desalination DSLNAH, Vol. 3, No. 1/3, p 341-357, November 1989. 2 tab, 19 ref.

Descriptors: *Belgard EV, *Desalination plants, *Evaporators, *Scaling, Distillation, Maintenance, Multistage flash evaporation, Optimization, Per-formance evaluation, Polymers, Temperature.

Since its introduction in 1973, BELGARD has almost become synonymous with scale control ad-

ditives for multistage flash evaporation plants and ditives for multistage flash evaporation plants and other processes involving the distillation of seawater. The initial impetus has been maintained over the last fifteen years by continued research and development. On-site trials and evaluation with the cooperation and assistance of plant manufacturers and end users, has resulted in improved plant performance and chemical dosing and better monitoring techniques. The early history of BEL-GARD EV and subsequent work leading to the introduction of BELGARD EV2000 is reviewed. introduction of BELGARD EV2000 is reviewed. The experience gained has shown that fouling can be effectively controlled in high temperature plants without recourse to acid dosing. The performance of high temperature additives, suggests that BELGARD EV can be complemented by sponge ball cleaning devices. In low temperature plant operation, the modern polymers have superior performance to polyphosphate based additives. All plants are individual and require optimization to find the correct compromise between dose rate and the use of sponge ball cleaning to give the best cost performance. (Lantz-PTT)

STUDIES ON MSF DESALINATION-PROCESS DESIGN, CONSTRUCTION AND START-UP OF A PROTOTYPE MSF PLANT IN INDIA. Bhabba Atomic Research Centre, Bombay (India). Desalination Div

P. K. Tewari, M. S. Hanra, R. K. Verma, and M.

Desalination DSLNAH, Vol. 3, No. 1/3, p 359-370, November 1989. 2 fig, 3 tab, 2 ref.

Descriptors: *Desalination plants, *Design standards, *India, *Multistage flash evaporation, Equipment, Performance evaluation, Pilot plants, Water treatment facilities.

A desalination experimental facility (DEF) made up of a multistage flash (MSF) unit with a 15 cu m/day capacity and three stages, had been commissioned and operated for about two years to study the basic parameters of the MSF process. On the basis of operational experience, the data col-lected from experiments, and the information availlected from experiments, and the information available from the literature, a 33 stage 425 cu m/day MSF plant was designed, fabricated, installed, and commissioned. This prototype plant is the first such unit in India. The design considerations for this 425 cu m/day prototype MSF plant and the factors to be considered for scale-up to commercial size plants are discussed. One of the factors to be considered during scale-up is the width of the MSF modules. As the capacity increases, the width of the module will increase linearly. For commercial plants, the width/height ratio of condenser tube bundles for flash stage is likely to be different from the ratio fixed in the prototype MSF. Care must also be taken during the design of commercial MSF plants to avoid an excessive pressure drop for the flow of vapor in the condenser tube bundles, because an increase in pressure drop reduces the the flow of vapor in the condenser tube bundles, because an increase in pressure drop reduces the heat transfer driving force. The long-term operational experience that will be gained from the prototype plant should be adequate for the design, fabrication and operation of MSF plants in the capacity range of 5,000-10,000 cu m/day. Also, the prototype MSF will serve the purpose of training the operational staff to handle the operation of commercial desalination plants in the future. (Lantz-PTT) W90.07454

PREVENTION OF THE SCALE TROUBLE OF MULTI-EFFECTS STACKED DESALINATION PLANT.

Mitsubishi Heavy Industries Ltd., Tokyo (Japan). Y. Fujioka, M. Soda, M. Zama, and I. Shimizu. Desalination DSLNAH, Vol. 3, No. 1/3, p 371-383, November 1989. 11 fig, 8 tab, 5 ref.

Descriptors: *Desalination plants, *Maintenance, *Scaling, Corrosion, Hydrogen ion concentration, Seawater, Titanium, Water temperature.

A new scale prevention method was studied in order to adapt the top seawater temperature of > 100 C in a multiple effect distillation process. The

Saline Water Conversion—Group 3A

experimental apparatus was designed so that the seawater flows down on the surface of an evaporation plate of 10 mm width and 220 mm length with falling film. It became clear through the test that the surface was prevented from scale precipitation by keeping the pH value of the seawater at 5.3, and keeping surface vaporization of the seawater, without nuclear boiling, at a temperature of 130 C. Even when scale precipitation was seen on the evaporation plate surface in poor operation, the scale was easily removed from the surface by reducing the pH value of the sea water to 1 or 2, for several minutes. It was certified through autoclave tests that titanium is a suitable plate material against crevice corrosion and general corrosion in the seawater of pH 5.3 and top sea water temperature of 130 C. As a result, top seawater temperatures of 130 C can be applied to the actual multiple effect distillation process. (Author's abstract) \$\text{W} 90-07455

EXPERIENCE WITH DESALINATION PLANTS IN LIBYA.
Department of Chemical Engineering, Tripoli GSPLAG, Libya.
A. I. El-Twaty, and S. A. Karshman.
Desalination DSLNAH, Vol. 3, No. 1/3, p 385-396, November 1989. 2 fig, 5 tab, 8 ref.

Descriptors: *Desalination plants, *Developing countries, *Libya, *Maintenance, *Water treatment facilities, Corrosion, Multistage flash evaporation, Personnel, Stainless steel.

Multistage flash (MSF) plants have been introduced into Libya since 1976. Up to 1988, the installed capacity had grown to approximately 300,000 cu m/day. Only 2/3 of the plants are currently operable. The availability of the plants as laso low, representing < 66 days/year. The most important problems are maintenance and the unavailability of skilled personnel. Corrosion is another important factor which controls the design and operation of the MSF plants. Most of the early plants were constructed from carbon steel for the evaporator shell with epoxy and Cu-Ni 90/10 for the heat exchanger. When problems from corrosion became severe, many solutions were adapted to improve the availability of the plant. For example: (1) for newly designed and constructed plants, better quality materials are chosen. The evaporators are constructed either completely in stainless steel or partially up to the demister, with stainless steel. The heating surface is constructed from either Cu-Ni 70/30 in recovery stages and titanium alloy in rejection stages, or totally in Cu-Ni 70/30, and (2) for existing plants the following changes are being carried out—acid dosed plants are switching to high temperature additives (Belgard), stainless steel cladding is being provided for the evaporator body, and vacuum system capacity is being increased to reduce the amount of non-condensable gases. These measures have increased the availability of the units. (Lantz-PTT)

LOCALIZED CORROSION AT WELDS IN STRUCTURAL STEEL UNDER DESALINA-TION PLANT CONDITIONS, PART I: EFFECT OF SURFACE ROUGHNESS AND TYPE OF WELDING ELECTRODE.

University of Petroleum and Minerals, Dhahran (Saudi Arabia). Petroleum and Gas Technology Div.

N. M. A. Eid.
Desalination DSLNAH, Vol. 3, No. 1/3, p 397-406, November 1989. 4 fig, 2 tab, 6 ref.

Descriptors: *Corrosion, *Desalination plants, *Materials testing, *Stainless steel, Chromium, Maintenance, Nickel, Welding.

Research was conducted into the causes of and remedies for seawater corrosion in desalination plants. An experimental program was undertaken to identify the pertinent factors which determine the corrosion behavior of structural steels and welds under desalination plant conditions and to optimize the welding process variables. The work involved: (1) the correlation of such variables as type of welding process and procedure (number of

passes, welding rate, etc.), electrode composition, heat treatment processes, with the corrosion properties of weld metal and welded test pieces in high temperature seawater. (2) the determination of any galvanic effects; and (3) the comparison of separate corrosion rates of weld metal, HAZ and parent metal and then correlation with the microscopical structure of the various regions. Surface finish was one of the major factors regulating corrosion. Under particularly severe conditions (stagnant seawater, marine organisms) a rough surface is better than a polished finish. More pits form on rough surfaces, but they are shallower, while lime salts are deposited more easily and may exert a protective effect. All specimens were periodically examined at very low magnification, sometimes by the unaided eye; irrespective of surface roughness and test temperature, specimens in all materials had suffered pitting and perforation. In stainless steel/stainless steel specimens (welding process STAIN-ARC MN), very small pits were observed on the surface of the specimens, which seemed to be associated with the zone affected by welding. In stainless steel/mild steel part of the specimen; no evidence of corrosion was seen at the weld metal or in the stainless steel part of the specimen; however, concerning the severity of corrosion in the HAZ is less than that in the parent metal, which is attributable to the diffusion of Cr and Ni in the HAZ. (See also W90-07458) (Lantz-PTT)

LOCALIZED CORROSION AT WELDS IN STRUCTURAL STEEL UNDER DESALINA-TION PLANT CONDITIONS, PART II: EFFECT OF HEAT TREATMENT, TEST TEMPERA-TURE AND TEST MEDIA.

TURE AND TEST MEDIA.
University of Petroleum and Minerals, Dhahran
(Saudi Arabia). Petroleum and Gas Technology
Div.

N. M. A. Eid. Desalination DSLNAH, Vol. 3, No. 1/3, p 407-415, November 1989. 2 fig, 2 tab, 16 ref.

Descriptors: *Corrosion, *Desalination plants, *Materials testing, *Stainless steel, Flow velocity, Maintenance, Seawater, Temperature, Welding.

Research was conducted into the causes of and remedies for seawater corrosion in desalination plants. An experimental program was undertaken to identify the pertinent factors which determine the corrosion behavior of structural steels and welds under desalination plant conditions and to optimize the welding process variables. Between the weld metal, which reaches its melting point and above, and the cold parent metal, there are zones within which all intermediate temperatures are reached promoting localized changes in the microstructure. Heat treatment is an operation involving the heating of the solid metal to definite temperatures, followed by cooling at suitable rates in order to obtain certain changes in the nature, form, size and distribution of the microconstituents. Studies show an accelerated effect on the corrosion rate due to elevated temperature. Generally, when corrosion is controlled by the diffusion of oxygen, the corrosion rate at a given oxygen concentration approximately doubles for every 30 C rise in temperature. When corrosion is attended by hydrogen evolution, the rate of increase will increase—more than double for every 30 C rise in temperature. Comparison studies were conducted in synthetic and natural seawaters. Inspection of the results reveal an appreciable difference in the effects of these two corrosive media. Stainless steel gave very good results in synthetic seawater, but in natural seawater, pitting corrosion occurred-pitting is essentially the only form of attack. The relative velocity of the seawater has a major influence on the corrosion shart constitute so great a danger cannot form so readily when the water is in motion; compared with stagmant water the oxygen supply that maintains passivity remains more constant. Water pumped at a velocity of 1.5 m/sec is much less corrosive than stagnant water. (See also We0-07458

OPERATING EXPERIENCE OF MSF DESALI-NATION PLANT AT THE ABU KAMMASH CHEMICAL COMPLEX. Alfatch Univ., Tripoli (Libya). Dept. of Civil En-

gineering. N. K. Pareek, A. Aboudher, H. M. H. Beck, and M. M. Elgarni.

Desalination DSLNAH, Vol. 3, No. 1/3, p 417-428. November 1989. 2 fig 5 tab.

Descriptors: *Desalination, *Industrial water, *Water treatment facilities, Heat transfer, Libya, Maintenance, Multistage flash evaporation, Performance evaluation, Potable water, Scaling.

A multistage flash (MSF) plant was provided as an auxiliary unit at Abu-Kammash Chemical Complex to meet the demand of process water, and domestic water for the town. The plant, with a nominal capacity of 100 cu m/rt, has 29 stages (24 heat recovery stages, 4 heat rejection stages and 1 degassing stage) and has been in operation since 1981. Though working at slightly under capacity, the overall performance of the plant is quite satisfactory. Throughout the period of operation, the actual thermal performance of the plant has fairly matched the design conditions. Incrustation of the heat transfer surfaces is kept under control by using an antiscalant along with an antifosam agnit. It is observed that except for the brine heaters, the scale problems are insignificant and the requirements for acid cleaning are infrequent. However, variations in the performance ratios clearly indicate the effect of aging on the plant. (Author's abstract)

LIGHT GAUGE WELDED TITANIUM TUBES FOR SEAWATER DESALINATION PLANTS. For primary bibliographic entry see Field 8G. W90-07460

SOME ASPECTS OF THE DEVELOPMENT AND OPERATION OF THE DESALINATION INSTALLATIONS WITH HORIZONTAL-TUBE THIN-FILM EVAPORATORS.

Akademiya Nauk SSSR, Sverdlovsk. Inst. of Physical Chemistry.

V. I. Podbergznyi, J. K. Smirnov, and J. V.

V. I. Podbereznyi, J. K. Smirnov, and J. V. Putalin.

Desalination DSLNAH, Vol. 3, No. 1/3, p 447-455, November 1989. 6 fig.

Descriptors: *Construction materials, *Desalination plants, *Evaporators, *Hydraulic equipment, *Water treatment facilities, Aluminum, Design standards, Distillation, Scaling, Stainless steel, Temperature.

Development work carried out in the USSR has allowed the creation of a head prototype for distillation desalting installations equipped with horizontal tube thin-film evaporators (HTTFE) of different dimensions. Their specifications as well as the description of their flow diagrams, HTTFE construction and operating experiences are given. Several statements can be made concerning the creation of these evaporators: (1) the heat engineering flow sheet is concurrent with a partially concurrent seawater feeding; (2) there is a unitype arrangement—each unit consists of 3-6 evaporation stages; (3) structural accomplishment of the HTTFE is an aggregative multistage construction for low capacity installations or, a completely separate factory-made stage, corresponding to the railway dimensions adopted in the USSR; (4) shell-and-tube condensers are heated with steam from the HTTFE being blown through to preheat the initial seawater. This set-up allows for good ventilation of the HTTFE tube bundles and an even distribution of the heating steam; (5) scale prevention is accomplished by microdosing with a polyelectrolyte developed in the USSR; and (6) construction materials include aluminum brass tubes operating at temperatures > 65 C stabilized with arsenic. At temperatures | 65 C, an Al-alloy containing approximately 2% magnesium is used. For body components coming into contact with seawater, a low alloy

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A-Saline Water Conversion

MC-1 or corrosion resistant steel is used. (Lantz-PTT) W90-07461

CORROSION BEHAVIOUR OF ALUMINUM-BASE ALLOYS IN DESALINATION PLANTS. Akademiya Nauk SSSR, Sverdlovsk. Inst. of Physical Chemistry. For primary b W90-07462 bibliographic entry see Field 8G.

3B. Water Yield Improvement

NETWORK DESIGN FOR WATER SUPPLY PORECASTING IN THE WEST. Hydex, Inc., Vienna, VA. For primary bibliographic entry see Field 7A. W90-06826

RISK ASSESSMENT AND DROUGHT MAN-AGEMENT IN THE THAMES BASIN. Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 2E. W90-07026

HUMIDITY WATER VAPOUR COLLECTION BY ABSORPTION COOLING MACHINES. BY ABSORPHON COOLING MACHINES. King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering. S. E. Aly. Desalination DSLNAH, Vol. 3, No. 1/3, p 139-165, November 1989. 6 fig, 14 ref.

Descriptors: *Absorption, *Air conditioning, *Condensation, *Desalination, *Potable water, *Water cooling, *Water supply, *Water vapor, Equipment, Humidity, Water temperature.

A method has been developed to produce fresh water by collecting the humidity water vapor in humid hot climates as a by-product of an air-conditioning system. This is achieved by employ-ing a LiBr-H20 absorption cooling machine with an open absorber where the outside ventilation air an open absorber where the outside ventilation air is brought in direct contact with the absorbent concentrated solution. Consequently, the air is dehumidified and the diluted solution is regenerated in the generator at a moderate temperature level. The concentrated solution repeats the dehumidification process while the vapor released (humidity) is used to fire two generators at lower pressures to promote the required cooling effect in the evaporar and the condensed vapor represents the fresh water by-product of the system. The system was thermodynamically analyzed and compared with an absorption machine with a closed absorber. Whenever the system was supplied by hot water at 140 C, it exhibit an overall coefficient of perform-140 C. it exhibit an overall coefficient of performance of 1.63, which is 54% more than the closed absorber machine and 30.5% more than an existing double effect absorption machine. As a case study, the system is powered by solar energy for a day school air conditioning. Results showed that beside air conditioning. Results showed that beside air conditioning, the system can provide about 38% of the daily water requirement for the school students at a daily production slightly higher than solar still basins. (Author's abstract)

3C. Use Of Water Of Impaired Quality

WASTEWATER EFFLUENT VS. SAFETY IN ITS REUSE: STATE-OF-THE-ART. Jordan Univ. of Science and Technology, Irbid. For primary bibliographic entry see Field 5D.

DETERMINATION OF A RATIONAL REDUCTION OF WATER WITHDRAWAL FOR IRRIGATION WITH CONSIDERATION OF WATER EXCHANGE AND WATER QUALITY. For primary bibliographic entry see Field 3F. W90-07044

IRON IN TUBEWELL WATER AND LINEAR GROWTH IN RURAL BANGLADESH. Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrolo-

A. Briend, B. A. Hoque, and K. M. A. Aziz. Archives of Disease in Childhood ADCHAK, Vol. 65, No. 2, p 224-237, February 1990. 2 tab, 6

Descriptors: *Bangladesh, *Drinking water, *Iron, *Public health, Child health, Growth, Health effects, Nutrition, Water quality, Well water.

Most underweight children in developing coun Most underweight children in developing countries are short compared with international growth standards. In Bangladesh, most drinking water comes from shallow tubewells. In some places, water coming out of these tubewells is heavily loaded in iron which gives a bad taste and appearance to water and makes it less suitable for cooking. This study examined the nutritional impact of water loaded with iron and assumed it would be executed with iron and assumed it would be water loaded with iron and assumed it would be associated with increased frequency of diarrhoea and malnutrition. However, the findings support the role of minerals to promote growth. The growth of 694 children from rural Bangladesh was growth of 694 children from rural Bangladesh was studied. Children drinking water containing > 1 mg iron/L (n=628) were significantly taller than those drinking < 1 mg iron/L (n=65) their mean height for age Z score (representing the difference of an anthropometric measure with the reference standard from the National Center for Health Statistics expressed in standard deviation units) was -2.10, compared with -2.45. This suggests that iron deficiency may contribute to growth retardation in poor communities. (Mertz-PTT)

PHOSPHORUS ENHANCEMENT OF SALT TOLERANCE OF TOMATO. New South Wales Dept. of Agriculture, Rydal-mere (Australia). Biological and Chemical Re-

search Inst

search Inst.
A. S. Awad, D. G. Edwards, and L. C. Campbell.
Crop Science CRPSAY, Vol. 30, No. 1, p 123-128,
January/February 1990. 2 fig, 1 tab, 30 ref.

Descriptors: *Fertilizers, *Phosphorus, *Salt tolerance, *Tomatoes, Chlorides, Foliage, Potassium, Salinity, Sodium.

Increasing plant P supply has been shown to either increase or decrease the salt tolerance of many plants. Tomato plants (Lycopersicon esculentum) were grown in a greenhouse in a continuously flowing solution culture system to investigate whether P fertilization modified the detrimental effects of NaCl at low constant P concentrations similar to those in soil solutions. Increasing P fertilsimilar to those in soil solutions. Increasing P tertuization enhanced the tolerance of tomato plants to NaCl. At 0.1, 1.0, and 10 mM P, the NaCl concentrations that reduced yields of fruit by 50% were 58, 72, and 130 mM, respectively. Salinity reduced foliar P concentrations. This may have been mediated to the property of the prope ated partly through ionic strength effects, which decreased the activity of orthophosphate ion by about 40%. Plants grown under saline conditions had higher internal P requirements. When the NaCl concentration was increased from 10 to 50 NACL concentration was increased from 10 to 50 and 100 mM, the corresponding concentrations of P in the youngest mature leaf required to obtain 50% yield were increased from 1.8 to 2.4 and 3.0 g/kg. The change in internal P requirement was also evident by the relative severity of foliar symptoms of P deficiency in plants growing in the saline also evident by the relative severing or lonar symp-toms of P deficiency in plants growing in the saline treatments at any given foliar P concentration. Adequate P nutrition was essential for effective ionic compartmentation. Under saline conditions, increasing the solution P concentration from 1.0 to 10 micromol decreased Na and increased K concentrations in immature leaves but increased Na and decreased K in the mature leaves. Accumulation of ions for osmotic adjustment and restriction of Na and Cl accumulation in immature leaves appear to be involved in P enhancement of salt tolerance of tomato alent. to be involved in P enhancement of tolerance of tomato plants. (Author's abstract) W90-07407

TREATED WASTEWATERS AS A GROWING WATER RESOURCE FOR AGRICULTURE

King Saud Univ., Riyadh (Saudi Arabia). Dept. of Chemical Engineering. I. S. Al-Mutaz. Desalination DSLNAH, Vol. 3, No. 1/3, p 27-36,

November 1989. 3 fig, 5 tab, 4 ref.

Descriptors: *Agricultural water, *Municipal wastewater, *Saudi Arabia, *Wastewater irrigation, *Wastewater treatment, *Water reuse, Arid zone, Irrigation, Public health, Water demand, Water quality.

About 72% of the 1985 Saudi Arabia water consumption was for agriculture. Wastewater treatment supplies only 5% of the Saudi water balance. By the year 2000, wastewater could account for > 20% of the total water supply. The reuse of municipal wastewaters for irrigation is the oldest and largest reuse. Health considerations are minimal for irrigation of non-food crops. Advance treat-ment of wastewaters is not strictly required. The ment of wastewaters is not strictly required. The advantages of using treated wastewater for irrigation are: low-cost source of water; an economical way to dispose of wastewater to prevent pollution and sanitary problems; an effective use of plant nutrients contained in wastewater; and, providing additional treatment before being recharged to the groundwater reservoir. The growing agriculture water demand in Saudi Arabia is due to the recent attention the government has paid toward agriculture activities. Saudi Arabia now attains self-sufficiency of national wheat production; surplus wheat ciency of national wheat production; surplus wheat being exported to Europe and nearby countries. The annual wheat production was 141,732 tons in 1980. It was increased to 2,048,000 tons in 1985, about 1350% increase. This vast agriculture water requirement can be obtained from the treated wastewater specially for non-food products. The Riyadh wastewater treatment plant is the first large plant in operation in the country, with a maximum plant capacity of 370,000 cu m/day. This rapid expansion is due to the fast growth of the city. Generally, the physical and chemical characteristics. ciency of national wheat production; surplus wheat city. Generally, the physical and chemical characteristics of Riyadh treated wastewater are within teristics of Riyaan treated wastewater are witnin
the standards required for unrestricted irrigation.
From a sanitary viewpoint, no crops which come
in contact with sewage should be irrigated with
treated wastewater. Also, no crops that are eaten
raw or that do not have skin to be removed before eating, are allowed to be cultivated on a sewage farm. (Lantz-PTT) W90-07432

3D. Conservation In Domestic and Municipal Use

PROBLEMS OF THE ARAL SEA AND

For primary bibliographic entry see Field 6G. W90-07167

DETERMINANTS OF HOUSEHOLD WATER CONSERVATION RETROFIT ACTIVITY: A DISCRETE CHOICE MODEL USING SURVEY

California Univ., Los Angeles. Dept. of Econom-

For primary bibliographic entry see Field 6D. W90-07348

3E. Conservation In Industry

IMPROVED ALGORITHM FOR HYDROPOW-ER OPTIMIZATION.

Manitoba Univ., Winnipeg. Dept. of Civil Engineering.

K. K. Reznicek, and S. P. Simonovic.

Water Resources Research WRERAQ, Vol. 26, No. 2, p 189-198, February 1990. 7 fig, 6 tab, 34

Descriptors: *Hydroelectric power, *Linear programming, *Optimization, Algorithms, Data processing, Energy management, Management planning, Manitoba, Model studies.

Conservation In Agriculture—Group 3F

A new algorithm named 'energy management by successive linear programming' (EMSLP) was developed to solve the optimization problem of hydropower system operation. The EMSLP algorithm has two iteration levels: (1) at the first level a stable solution is sought and (2) at the second level the interior of the feasible region is searched to improve the objective function whenever its value decreases. The EMSLP algorithm was tested using the Manitoba Hydro system data applied to a single reservoir system. To evaluate the performance of the algorithm, the comparison was made with the results obtained by the energy management and maintenance analysis (EMMA) program used in Manitoba Hydro practice. The newly formulated algorithm achieved better results than the EMMA algorithm, thus indicating that Manitoba Hydro operations could be improved by application of EMSLP. (Author's abstract)

3F. Conservation In Agriculture

LAND DRAINAGE: AGRICULTURAL BENE-FITS AND ENVIRONMENTAL IMPACTS.

Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 551-557, December 1989. 3 fig, 4 tab, 50 ref.

Descriptors: *Agriculture, *Drainage, *Environmental policy, *Farming, Economic aspects, England

Agricultural drainage has made a major contribution to UK farming. The efficient operation and maintenance of land-drainage systems will increase in importance for many commercial farmers facing diminishing profit margins. Given changing agricultural and environmental priorities, environmental criteria will play a major part in future land-drainage improvement and maintenance activities. Initiatives by environmental groups, farmers, and government are helping to reconcile different interests, especially in areas where many valued environmental qualities are sustained by a managed, although traditional, farming system. The recent policy initiatives on farm diversification and extensification should provide further scope for matching economic and environmental criteria. In this context, a greater understanding of the interrelationship between water regime requirements for agriculture and environmental management can only be beneficial. It is an opportunity for environmental and agricultural specialists to work together. (Author's abstract)

USE OF A THERMAL SCANNER IMAGE OF A WATER STRESSED CROP TO STUDY SOIL SPATIAL VARIABILITY.

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). For primary bibliographic entry see Field 2G. W90-06737

POLICY IMPACTS ON AGRICULTURAL IRRIGATION ELECTRICITY DEMAND IN THE COLUMBIA BASIN.

Oregon State Univ., Corvallis. For primary bibliographic entry see Field 6A. W90-06820

FARM PROGRAM IMPACTS ON AN EX-HAUSTIBLE GROUNDWATER SUPPLY: AN ANALYSIS OF THE TEXAS SOUTHERN HIGH PLAINS.

Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusiness. For primary bibliographic entry see Field 6D. W90-06845.

STUDY OF SOIL WATER CHANGES IN A PEANUT FIELD (IN CHINESE).
National Taiwan Univ., Taipei. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.

W90-06905

DETERMINATION OF A RATIONAL REDUCTION OF WATER WITHDRAWAL FOR IRRIGATION WITH CONSIDERATION OF WATER EXCHANGE AND WATER QUALITY.
S. A. Sokolov.

S. A. SOKOIOV. Hydrotechnical Construction HYCOAR, Vol. 23, No. 4, p 194-199, 1990. 4 fig, 1 tab, 6 ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 25-28, April, 1989.

Descriptors: *Impaired water use, *Irrigation requirements, *Irrigation-return flow, *Mathematical analysis, *Reservoir operation, *Water conservation, *Water quality control, *Water reuse, Drainage water, Irrigation water, Water use.

Mathematical analysis has been made of the reduction of irrigation water used by reuse of the return runoff of collector-drain waters, taking the factors of water exchange and water quality into consideration. The case when a reservoir is used as the source for irrigation was studied, where the dimensionless coefficients of water exchange and water renewal are often used as a generalized hydrological-ecological characterization of water bodies. The relation between the coefficients of water exchange and water renewal of reservoirs was determined by a transcendental equation, which is expressed by a family of curves on a graph. The hypothesis that the average concentration of admixtures in a valley reservoir with a slow external water exchange is equal to the concentration at its outlet was tested by comparison with on-site data, showing a satisfactory convergence of the results. Average errors for the majority of factors checked (including ionic species) were about 5 to 10%. Analytic equations were obtained for calculating the quality of collector-drain waters and a graphic method of calculation is given. A scheme is presented for calculating the rational volume of water withdrawal for irrigation. (VerNooy-PTT)

MODELING WATER UTILIZATION IN LARGE-SCALE IRRIGATION SYSTEMS: A QUALITATIVE RESPONSE APPROACH.

Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics. C. A. Ferguson.

Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1199-1204, December 1989. 2 fig, 2 tab, 18 ref.

Descriptors: *Irrigation, *Mathematical models, *Water management, *Water use, Model testing, Philippines, Regression analysis, Social aspects.

Given limited available data and the present state of knowledge on the social aspects of irrigation, there is a need to develop new quantitative methods to measure water management performance in large-scale systems. A qualitative response framework is adapted to formulate a dynamic logit model of weekly field water adequacy and quantify indirectly farmer water utilization. Model parameters are estimated in a weighted least-squares regression using four seasons of data from a Philippine canal system. Estimated coefficients and independent model forceasts indicate greater effective use of rainfall than irrigation in sustaining high levels of water adequacy during the rainy season, while system location has a much smaller but still significant impact. Utilization rates for both rain and irrigation showed considerable responsiveness to the prevailing scarcity of water. The qualitative response approach is well suited to the aggregated data available for large-scale systems, and allows advances in modeling dynamic water management behavior. Formal evaluation of the model will require further empirical applications. (Author's abstract)

EFFECT OF ELODEA DENSA ON AQUACUL-TURE WATER QUALITY. National Univ. of Singapore. Dept. of Civil Engi-

National Univ. of Singapore. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5D.

W90-07225

TRANSIENT HYDRAULIC MODEL FOR SIM-ULATING CANAL-NETWORK OPERATION. Nairobi Univ. (Kenya). Dept. of Agricultural Engineering. For primary bibliographic entry see Field 8B. W90-07320

SHOOTING METHOD FOR SAINT VENANT EQUATIONS OF FURROW IRRIGATION. California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 8B. W90-07328.

GENETIC VARIANCES FOR FORAGE YIELD IN CRESTED WHEATGRASS AT SIX LEVELS OF IRRIGATION

IN CRESTED WHEATGRASS AT STATEFALS
OF IRRIGATION.
Agricultural Research Service, Logan, UT.
Forage and Range Research Lab.
K. H. Asay, and D. A. Johnson.
Crop Science CRPSAY, Vol. 30, No. 1, p 79-82,
January/February 1990. 1 fig, 4 tab, 19 ref.

Descriptors: *Drought effects, *Genetics, *Grasses, *Irrigation, *Range grasses, Clones, Heritability, Seasonal variation, Soil moisture, Wheatgrasses.

Rangelands in the western USA are characterized by extreme seasonal and site variations in soil moisture and extended periods of severe water deficit. Development of improved germplasm that is productive over a wide range of soil moisture conditions is a major objective of forage breeding programs in this region. Ample levels of heritable genetic variation are prerequisites for genetic progress in any breeding program. Although expression of genetic variability among breeding pines is known to decrease in some species as water becomes limited, neither this relationship nor the stability of genetic responses at different water levels have been studied in crested wheatgrass, Agropyron desertorum. A line-source sprinkler system was used under a field rainout shelter to evaluate the dry matter yield of 29 clonal lines of crested wheatgrass at six levels of water application. Forage yield declined linearly from optimum water levels to levels representative of severe drought. Broad-sense heritability values along with the range and genetic variance among clonal lines also declined markedly as water application decreased. Experimental error, as reflected by the coefficient of variation, was substantially larger under drought than at higher water applications. Although the clone x water level interaction was significant (P < 0.01). Positive and significant (P < 0.01). Positive and significant (P < 0.01) positive and significant (P < 0.01) positive and significant (P < 0.01) positive and significant (P of positive premit selection for forage dry matter yield at water levels substantially above the target level. (Author's abstract)

LEAF WATER CONTENT AND GAS-EX-CHANGE PARAMETERS OF TWO WHEAT GENOTYPES DIFFERING IN DROUGHT RE-SISTANCE.

Purdue Univ., Lafayette, IN. Dept. of Botany and Plant Pathology. For primary bibliographic entry see Field 2I. W90-07405

FIELD DROUGHT TOLERANCE OF A SOY-BEAN PLANT INTRODUCTION. North Carolina State Univ. at Raleigh. Dept. of Crop Science. For primary bibliographic entry see Field 2I. W90-07406

WATER-USE EFFICIENCY AND YIELD OF SAINFOIN AND ALFALFA.

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F-Conservation In Agriculture

Texas Tech Univ., Lubbock. Dept. of Agronomy, Horticulture, and Entomology. For primary bibliographic entry see Field 2I.

EFFECT OF LUCERNE ON RECHARGE TO CLEARED MALLEE LANDS: RESULTS OF A DRILLING PROGRAM AT BURONGA, EUSTON AND BALRANALD.

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water For primary bibliographic entry see Field 2G. W90-07484

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ECONOMIC FRAMEWORK FOR FLOOD AND SEDIMENT CONTROL WITH DETENTION

Maryland Univ., College Park. Dept. of Civil En-

gineering. G. E. Moglen, and R. H. McCuen.

Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 145-156, February 1990. 7 fig, 2 tab, 24 ref.

Descriptors: *Detention reservoirs, *Flood control, *Sediment control, Economic aspects, Water

A framework for combining economic factors and the hydrology of detention basins is provided. The general development of economic production functions for water quality (sediment) and flood control is examined. Example production functions are generated to compare water quality (sediment control only) and flood control. For the given example, the design of a detention basin for downstream sediment control is economically unwarranted. When compared to onsite detention facilities, regional detention structures appear to be more practional detention structures appear to be more pracgional detention structures appear to be more prac-tical from an economic standpoint for water qual-ity control. Since sediment was the only water ry control. Since sediment was the only water quality parameter assessed, it is entirely possible that the design of a detention basin for water quality control would be justified if the effects of all pollutants of concern could be quantified. The benefits that result from trapping pollutants, in-cluding sediment, are one of the most difficult elements of the water quality production function to assess. The estimation of benefits of instream to assess. In e-sumation to electis or instream flow is a relatively new area of investigation. Public goods, or non-marketed resources, are diffi-cult to assess, in part, because of the many benefici-aries involved and because many of the benefits are value-based. The benefits are also a function of the flow level, with greater water quality benefits ac-cruing during low flows, which compounds the problem of estimation. (Author's abstract) W90-06831

SAMPLING STOCHASTIC DYNAMIC PROGRAMMING APPLIED TO RESERVOIR OP-

Centro de Pesquisas de Energia Eletrica, Rio de Janeiro (Brazil).

J. Kelman, J. R. Stedinger, L. A. Cooper, E. Hsu,

A. Cooper, E. Assemger, L. A. Cooper, E. Assu, and S.-Q. Yuan.
Water Resources Research WRERAQ, Vol. 26, No. 3, p 447-454, March 1990. 3 fig, 5 tab, 21 ref.

Descriptors: *Dynamic programming, *Feather River, *Model studies, *Reservoir operation, *Stochastic models, Sampling, Streamflow.

Most models for reservoir operation optimization have employed either deterministic optimization or stochastic dynamic programming algorithms. This paper develops sampling stochastic dynamic programming (SSDP), a technique that captures the complex temporal and spatial structure of the streamflow process by using a large number of

sample streamflow sequences. The best inflow forecast can be included as a hydrologic state variable to improve the reservoir operating policy. variation to improve the reservoir operating poincy. Sampling stochastic dynamic programming as developed here employs the empirical multivariate temporal and spatial streamflow distribution for a basin, allowing the detailed simulation within the optimization model of the complex Feather River optimization motel of the complex reading SDP hydroelectric system. In this regard, sampling SDP has significant advantages over the traditional SDP approach. Because sampling SDP employs selected historical or synthetic streamflow trances, the actual multimonth persistence of streamflows can be captured in the calculation of the expected benefits. (Author's abstract)

DETERMINATION OF A RATIONAL REDUC-TION OF WATER WITHDRAWAL FOR IRRI-GATION WITH CONSIDERATION OF WATER EXCHANGE AND WATER QUALITY For primary bibliographic entry see Field 3F. W90-07044

EFFECT OF PH ON COPPER TOXICITY TO BLUE-GREEN ALGAE.

Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.

Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 74, No. 3, p 283-291, 1989. 5 fig, 2 tab, 22 ref.

Descriptors: *Copper, *Cyanophyta, *Hydrogen ion concentration, *Plant growth, *Toxicity.

Mobility, bioavailability and the toxicity of metals in natural water bodies are dependent on their physicochemical form. The acidification of a large number of natural waters due to deposition of atmospheric pollution may significantly alter the metal status, and induce metal stress in aquatic ecosystems with subsequent changes in the species composition. The effect of hydrogen ion concentration on copper toxicity to two planktonic bluegreen algae, Aphanizomenon gracile and Oscillatoria redekei, was investigated. Growth rates of the algae without copper treatment decrease with toria redekei, was investigated. Growth rates of the algae without copper treatment decrease with hydrogen ion concentration, Aphanizomenon af-fected earlier than Oscillatoria. The lowering of the hydrogen ion concentration leads to a toxicity enhancement sooner in Oscillatoria. In the acid ennancement sooner in Oscinatoria. In the activariancement sooner in Oscinatoria. In the activariance range, toxicity retardation occurs in Aphanizomenon. At pH concentration of 5.1, shortening of the interval between copper toxicity and copper stimulus is characteristic for both species. These results show that simultaneous copper treatment and hydrogen ion concentration shock could con-(Brunone-PTT)
W90-07098

INSTANTANEOUS PEAK FLOW ESTIMATION PROCEDURES FOR NEWFOUNDLAND STREAMS

Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
U. S. Panu, and D. A. Smith.

Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1151-1162, December 1989. 1 fig, 5 tab, 18 ref.

Descriptors: *Flood forecasting, *Flood peak, *Newfoundland, *Streamflow forecasting, Canada, Estimating equations, Flood flow, Flood frequency, Regression analysis, Streams.

procedure for estimating instantaneous flood A procedure for estimating instantaneous flows for various return periods on the Island of Newfoundland is presented. It is based on annual maximum instantaneous flows rather than annual maximum daily-mean flows, as the latter requires the conversion of estimated daily-mean flows into instantaneous flows. Regression equations were developed for each of three homogeneous regions for the desired return periods. The flood flow estimation capability of the presented procedure is better than any other currently available procedure on the Island. (Author's abstract)

RESERVOIR RELEASES TO USES WITH DIFFERENT RELIABILITY REQUIREMENTS.

University of New England, Armidale (Australia). C M Alaquize

Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1163-1168, December 1989. 4 fig, 1 tab, 13 ref.

Descriptors: *Reservoir operation, *Reservoir re-leases, *Water allocation, *Water management, *Water use, Reliability, Stochastic dynamic pro-

Releases from a reservoir may be allocated to a number of uses, each of which may require a given volume of water at a different reliability. A volume of water at a different reliability. A method is described that can be used to estimate the volume of water associated with a given reliability for each use of water when the proportion of releases allocated to each use is known. A functional relationship among desired release, reliability, and the proportion of releases allocated to each use was derived. This functional relationship can also be used to determine the proportion of can also be used to determine the proportion or releases that must be allocated to each use to deliver the required release at the specified reliabil-ity. These results can be used to evaluate the meeting of specified objectives under a published release policy derived by stationary stochastic dynamic programming. The results can also be used to solve water allocation problems when the prob-ability distribution of available water is known (or can be estimated) and water has multiple uses, each of which has different volume and reliability requirements. (Author's abstract)
W90-07205

PROPOSED MODIFICATION TO REGULA-TION OF LAKE OKEECHOBEE.

South Florida Water Management District, West Palm Beach. Water Resources Div. P. J. Trimble, and J. A. Marban.

Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1249-1257, December 1989. 6 fig, 1 tab, 12 ref.

Descriptors: *Aquatic habitats, *Florida, *Lake Okeechobee, *Lake management, *Lake storage, *Regulated flow, *Water supply, Consumptive use, Drought, Estuaries, Flood protection, Littoral zone, Scheduling.

The current Lake Okeechobee regulation schedule The current Lake Okeechobee regulation schedule is two feet higher than previous schedules that were in operation during the early 1970's. Its implementation was in response to prolonged periods of drought that occurred during the 1960's and early 1970's and the large increases in consumptive uses that were projected, and are presently occurring in south Florida. The additional storage provided by the schedule undoubtedly helped prevent more severe water shortages during the record setting 1980-1982 drought. However, two environmental concerns associated with the present schedule resurfaced in recent years with the return to mental concerns associated with the present schedule resurfaced in recent years with the return to more normal rainfall conditions. First, the present schedule allows frequent high water conditions to exist in the lake that appear to be stressful to the unique littoral zone habitat of the lake. Second, the allowable buildup of storage prior to the dry season, combined with the large required decrease in storage prior to the hurricane (wet) season, contribute to the need for large regulation releases to tidewater. These large discharges have undesirable impacts on ecosystems of the downstream estuaries. An alternative schedule is presented that anic impacts on ecosystems of the downstream estuaries. An alternative schedule is presented that better meets the needs of the estuarine habitats without negatively impacting the other objectives of managing the lake. (Author's abstract) W90-07214

GUIDELINES FOR REHABILITATION OF DRAINLINES CROSSED BY PIPELINES.

American Society of Civil Engineers, New York. Irrigation and Drainage Div. For primary bibliographic entry see Field 8A. W90-07325

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Groundwater Management—Group 4B

WATER MANAGEMENT AND ECOLOGICAL PERSPECTIVES OF THE UPPER RHINE'S

Institute for Floodplains Ecology, Rastatt (Germa-

For primary bibliographic entry see Field 6F. W90-07331

IMPACT OF CHANNELIZATION ON THE HY-DROLOGY OF THE UPPER RIVER MAIN, COUNTY ANTRIM, NORTHERN IRELAND: A LONG-TERM CASE STUDY.

Ulster Univ. at Jordanstown, Newtownabbey (Northern Ireland). Dept. of Computing Science. C. J. Essery, and D. N. Wilcock. Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 1, p 17-34, January/Febru-ary 1990. 10 fig. 2 tab, 25 ref.

Descriptors: *Channeling, *Main River, *Northern Ireland, *Surface-groundwater relations, Aquifers, Case studies, Drainage, Flood plains, Long-term studies, Monitoring, Water table.

The impact of an arterial drainage scheme on the water balance in the 200-sq km River Main catchment was quantified. Monitored changes in groundwater storage act as an independent check on conclusions about storage change derived from measurements of surface hydrology. Three sub-catchments of the study area and one other indecatchments of the study area and one other inde-pendent experimental catchment constitute con-trols against which the impact of arterial damage can be assessed. Five years' predrainage data and three years' post-drainage data were examined. Stream flow from the floodplain area of the catchment has increased, especially low flows. Catchment water tables, however, as monitored in floodplain transects and disused farm wells have not been drawn down. Any immediate drainage benetoeth drawn down. Any mineculat trainage cene-fits deriving directly from arterial drainage are difficult to detect. Groundwater evidence indicates that the likely source of the excess discharge is an underlying gravel aquifer that has been punctured by the deeper arterial channel. (Author's abstract) W90-07332

RIVER ENGINEERING IN NATIONAL PARKS: THE CASE OF THE RIVER WHARFE, U.K. University of East Anglia, Norwich (England). School of Environmental Sciences.

School of Environmental Sciences.
R. D. Hey, and A. N. Winterbottom.
Regulated Rivers Research & Management
RRRMEP, Vol. 5, No. 1, p 35-44, January/February 1990. 5 fig, 3 tab, 20 ref.

Descriptors: *England, *Flood control, *Wharfe Descriptors: *Legiand, *Priod Control, *Waarier, River, Bed load, Case studies, Dredged material, Erosion, Flood plains, National parks, Performance evaluation, River sediments, Sediment yield, Trap efficiency.

River engineering works recently have been car-ried out in the upper River Wharfe (England) to reduce the flood risk and restore land drainage between Hubberholme and Kettlewell. As the river is located in a National Park, great care had to be exercised to limit the degree of interference and to ensure that an environmentally acceptable solution was adopted. The increased flood risk can solution was adopted. The increased flood risk can be attributed partially to afforestation in the head-waters of the Wharfe. Improved drainage prior to planting led to an apparent increase in the magnitude and frequency of flooding and an increase in sediment yield. The works were aimed to remedy both problems and were designed in consultation with a range of conservation and amenity organizations. First, a bed load trap was constructed on the Wharfe to curtail the sediment supply to the flood-more reach and prevent further aggradation. flood-prone reach and prevent further aggradation. Second, limited dredging was carried out near tributary junctions to improve land drainage on the floodplain. Third, the dredged material was used to form the core of the raised banks. The engineering works were carried out between 1985 and 1987. Since completion in August 1987 the flood banks have been overtopped only twice, compared to a previous record of 32 times per year. No significant erosion or deposition has occurred and the gravel trap is performing as expected (half full after 2.5 yr of operation). Although stocks of

mature trout were displaced by bed workings, there are now signs of a recovery. (Author's ab-W90-07333

RESTORATION AND ENHANCEMENT OF ENGINEERED RIVER CHANNELS: SOME EU-

ROPEAN EXPERIENCES.
Thames Water Authority, Reading (England). Rivers Div.

A. Brookes. Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 1, p 45-56, January/February 1990. 5 fig, 2 tab, 23 ref.

Descriptors: *Denmark, *England, *Management planning, *River restoration, Elbaek River, Ero-sion, Hydrology, Lambourn River, Performance evaluation, River sediments.

As governments and organizations responsible for river management throughout the world become increasingly aware of the need to reconcile engineering objectives with nature conservation, alterative strategies for river management, such as restoration, are likely to continued to be developed and applied. Based on the experiences of 15 resto-ration projects in Denmark and Britain, the criteria ration projects in Denmark and Britain, the criteria that determine the success of such projects are outlined. The essential precursor to a successful restoration project is a thorough feasibility and planning study. The type of restoration work included in a project is constrained by a number of factors, including the physical environment and the project objectives. The detailed design needs to the project objectives. The detailed usage needs to be tailored to the individual river reaches under consideration. Project planning should consider the timing and supervision of construction and make recommendations on the nature of maintenance. A management plan is desirable and post-project appraisal is essential to evaluate the longterm hydraulic and environmental performances. These criteria were applied to two projects carried out recently: River Lambourn in Berkshire, England, and the Elbaek in central Jutland, Denmark. Both projects appear to have been successful because they have stream powers in the middle range of values, neither too high to cause significant erosion, nor too low to be inundated with sediment. Existing methods of assessing the feasibility of restoration projects are crude, but provide some guidance in avoiding severe problems. Most of the available techniques are not applicable to highenergy, braided river channels. (Rochester-PTT) W90-07334 term hydraulic and environmental performance

TIME SCALES FOR THE RECOVERY POTEN-TIME SCALES FOR THE RECUVERY PUTENTIAL OF RIVER COMMUNITIES AFTER RESTORATION: LESSONS TO BE LEARNED FROM SMALLER STREAMS.
Karlsruhe Univ. (Germany, F.R.). Zoologisches

For primary bibliographic entry see Field 2H. W90-07337

ENGINEERING OPERATIONS AND INVERTEBRATES: LINKING HYDROLOGY WITH

Leicester Univ. (England). For primary bibliographic entry see Field 6G. W90-07338

IMPROVED ALGORITHM FOR HYDROPOW-ER OPTIMIZATION.

Manitoba Univ., Winnipeg. Dept. of Civil Engi-For primary bibliographic entry see Field 3E.

4B. Groundwater Management

FARM PROGRAM IMPACTS ON AN EX-HAUSTIBLE GROUNDWATER SUPPLY: AN ANALYSIS OF THE TEXAS SOUTHERN HIGH PLAINS.

Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusines

For primary bibliographic entry see Field 6D.

SOME GENERAL RESULTS ON THE SEEP-AGE EXCLUSION PROBLEM.

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.

For primary bibliographic entry see Field 2G. W90-06846

OPTIMIZATION MODEL FOR UNCONFINED STRATIFIED AQUIFER SYSTEMS.

Utah Water Research Lab., Logan. For primary bibliographic entry see Field 2F. W90.06891

OPTIMAL PUMPING POLICY AND GROUND-WATER BALANCE FOR THE BLUE LAKE AQ-UIFER, CALIFORNIA, INVOLVING NONLIN-EAR GROUNDWATER HYDRAULICS.

Indian Inst. of Tech., Bombay. Dept. of Civil Engineering.

Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 177-194, November 1989. 10 fig, 1 tab, 31 ref,

Descriptors: *California, *Drawdown, *Ground-water management, *Hydrologic budget, *Water yield, Blue Lake aquifer, Hydrologic models, Man-agement planning, Mathematical equations, Mathe-matical models, Optimization, Pumping, Ruth Res-

The Blue Lake aquifer (BLA) is an unconfined sloping aquifer in Northern California traversed by the Mad River, which is regulated by Ruth Reservoir. High pumpage from the existing six wells operated by Humboldt Bay Municipal Water District (HBMWD) of the order of a few million gallons per day (MGD) caused appreciable draw-down compared to the saturated thickness of the aquifer. Additionally, HBMWD also proposed another set of 10 wells for meeting and anticipated water demand of 23 MGD of Humboldt County. Consequently, reduction of the governing anoling. Consequently, reduction of the governing nonlin-ear groundwater flow equation into a linear equawas not considered appropriate. An existing tion was not considered appropriate. An existing explicit scheme coded by previous workers for this project was found most suitable for the solution of inherent nonlinear equations. However, many modifications in the existing algorithm were required before a groundwater balance was obtained for the BLA. HBMWD wanted to minimize pumpquired before a groundwater balance was obtained for the BLA. HBMWD wanted to minimize pumping cost for lifting the proposed 23 MGD from the 10 wells. This required the simulation of a groundwater management model of the aquifer involving the principles of nonlinear optimization. A recent Modified Embedded Approach was used to solve the problem incorporating the appropriate constraints based on the real system and on the optimization requirements. It was estimated that HBMWD could have an annual saving of \$20,000 by implementing an annual optimal pumping policy with monthly planning periods compared to a suboptimal pumping policy (i.e., equal pumping of 2.3 MGD from 10 wells). (Author's abstract) W90-06893 W90-06893

INTEGRATION OF SURFACE AND GROUND-WATER RESOURCES FOR THE DEVELOP-MENT OF HAMAD BASIN PROJECT.

Arab Center for the Studies of Arid Zones and Dry Lands, Damascus (Syria).

N. Rofail, and S. I. Asaad.

Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 3, p 173-181, November/ December 1989. 4 fig, 2 tab, 8 ref.

Descriptors: *Aquifer systems, *Conjunctive use, *Groundwater resources, *Hamad Basin, *Water conservation, *Water resources development, Geography, Geohydrology, Iraq, Jordan, Remote sensing, Saudi Arabia, Social needs, Surface runoff, Syria.

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B-Groundwater Management

Hamad Basin (166,000 square kilometers) is an extensive basin, inhabited by 219,000 people. It is located in the arid region within the border of four Arab States: Syria, Jordan, Iraq, and Saudi Arabia. Average annual precipitation is 78 mm, falling mostly during winter. Integrated studies of the natural resources (water, soil, range, and animals) were carried out with other complementary studies. were carried out with other complementary studies to formulate a socioeconomic development plan for the promising areas within the basin. Modern technologies were applied such as remote sensing, isotope analysis, processing, and documenting of basic hydrogeological data within the data bank system using computer facilities. Results revealed that the output of the natural dry plant production amounts to two million tons. The animal wealth population comprises 2 million head, mainly sheep. Average annual surface runoff is 146 million cubic meters, which could be appropriately exploited in water spreading schemes to improve its range. Water lost presently through evaporation from vast flat depressions could be conserved through deepening these depressions and recharging shallow perched aquifers by surface runoff which could be mined later. Results of regional geology, partial geophysical studies, and hydroelectrical hydrochemical interpretations have concluded the existence of two main aquifer systems. The first lies hydrochemical interpretations have concluded the existence of two main aquifer systems. The first lies within the tertiary and quaternary formations, while the second extends to the mesozoic and paleozoic. Their yield varies quantitatively and qualitatively. Up to 100 million cubic meters could be safely drawn annually. One compound pilot project was selected within the sector of each of the four Arab States to test the feasibility of the proposed development program for the promising areas of the basin. (Author's abstract)

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF POWER-LINE CONSTRUCTION ON WETLAND VEGETATION IN MASSACHU-

SETTS, USA.
Tufts Univ., Medford, MA. Dept. of Biology.
N. H. Nickerson, R. A. Dobberteen, and N. M.

Environmental Management EMNGDC, Vol. 13, No. 4, p 477-483, July/August 1989. 4 fig, 24 ref.

Descriptors: *Aquatic plants, *Electrical equipment, *Environmental effects, *Massachusetts, *Revegetation, *Wetlands, Bogs, Cattails, Ecosystems, Swamps, Utilities, Vegetation.

Utility rights-of-way corridors through wetland areas generate long-term impacts from construction activities to these valuable ecosystems. Changes to and recovery of the vegetation communities of a cattail marsh, wooded swamp, and shrub/bog wetland were documented through measurements made each growing season for two years prior, five years following, and again on the tenth year after construction of a 345-kilovolt transmission line. While both the cattail marsh and wooded swamp recovered within a few years, measures of plant community composition in the shrub/bog wetland were still lower, compared to controls. After ten years, the wooded swamp has apparently recovered from impacts caused by construction activities. As a consequence of construction activities. Utility rights-of-way corridors through wetland apparently recovered from impacts caused by con-struction activities. As a consequence of construc-tion activities and periodic right-of-way mainte-nance, a fairly stable and highly diverse shrub community developed under the power lines built in 1978. The dense shrub cover inhibits further growth of tree seedlings, resulting in less demand for right-of-way maintenance. In contrast to results for the wooded wetland, data for the shrub/bog wetland reveal that even after ten years, the area under the new right-of-way does not fully resem-ble either the old right-of-way or control areas with respect to the vegetation parameters measured in this study. The shrub/bog wetland had significantly lower average numbers of individuals and species after ten years of recovery. It appears that bogs, at least in Massachusetts, are sensitive wetland ecotypes, such that damage to vegetation communities caused by construction activities is clearly detectable ten years later. The cattail marsh

recovered within essentially one year after construction of the transmission lines, as revealed by previous work and the present study. Cattails are known to be aggressive emergent wetland species, primarily deriving from their capacity for high biomass production, vigorous vegetation reproduction, and rapid spring regrowth from carbohydrate storage reserves in rhizomes. Long-term investigastorage reserves in rinzolmes. Long-term investiga-tions such as the one reported here help decrease uncertainty and provide valuable information for future decision making regarding construction of power utility lines through valuable and dwindling wetland resources. (Brunone-PTT) W90-06611

ADDITIONS TO THE DIATOMS OF VIRGIN-IA'S INLAND FRESH WATERS: LAKE BAR-CROFT, FAIRFAX COUNTY, VIRGINIA. George Washington Univ., Washington, Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H. W90-06653 Washington, DC.

IMPACT OF TIMBER HARVESTING AND PRODUCTION ON STREAMS: A REVIEW. Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
I. C. Campbell, and T. J. Doeg.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 5, p 519-539, 1989. 2

fig. 162 ref.

Descriptors: *Forest hydrology, *Forest management, *Literature review, *Logging, *Streams, Australia, Ecosystems, Flood peak, Forest watersheds, Riparian vegetation, Sediment transport, Sedimentation, Sediments, Stream biota, Water

Timber harvesting operations have significant effects on both water quantity and quality. The effects on water quantity have been well documented both in Australia and elsewhere. The effects on water quality are less widely appreciated, and include elevated concentrations of dissolved salts, suspended solids and nutrients, especially during peak flow periods. Several Australian studies have failed to measure peak flow transport of suspended solids, or have measured it inadequately. suspended solids, or have measured it inadequately, thus severely underestimating transport. The major short-term effects of timber harvesting on the aquatic biota result from increased sediment input into streams or increased light through damage to, or removal of, the riparian vegetation. Sediment which settles on, or penetrates into, the stream bed is of more concern than suspended sediment, and can lead to long-term deleterious changes to fish and invertebrate populations. Increased light causes an increase in stream primary production which may increase invertebrate densities, and alter community composition. These biological consequences have not yet been adequately investisuspended solids, or have measured it inadequately, consequences have not yet been adequately investi-gated in Australia. Longer-term effects, as yet not investigated in Australia, include changes to stream investigated in Austrain, include changes to stream structure as the regrowth forest has fewer large logs to fall into the stream. These large logs play a major role as habitat and retention structures in streams. There has been no attempt to evaluate the streams. I here has been no attempt to evaluate the effects of timber production activities, including pesticide use and fuel reduction burning, on the Australian stream biota. Likewise, although buffer zones are widely advocated as a protection measure for streams in Australia, there have been no studies to evaluate their effectiveness. (Author's abstract) W90-06659

APPLICATION OF REMOTE SENSING TO ES-TIMATE LAND COVER FOR URBAN DRAIN-AGE CATCHMENT MODELLING. For primary bibliographic entry see Field 7B. W90-06714

EVALUATION OF BEST MANAGEMENT PRACTICES FOR CONTROLLING NONPOINT POLLUTION FROM SILVICULTURAL OPER-

Pennsylvania State Univ., University Park. School

For primary bibliographic entry see Field 5G. W90-06821

NUTRIENT DISTRIBUTION AND VARIABILI-TY IN THE CHARLOTTE HARBOR ESTUA-RINE SYSTEM, FLORIDA.

Geological Survey, Tampa, FL.
For primary bibliographic entry see Field 5B. W90-06824

INTEGRATED USE OF NATURAL RE-SOURCES AND GEOENVIRONMENT. Stavebni Geologie, Prague (Czechoslovakia). Hydrogeology Dept.
For primary bibliographic entry see Field 6G. W90-06958

INDUCED CHANNEL ENLARGEMENT IN SMALL URBAN CATCHMENTS, ARMIDALE, NEW SOUTH WALES.

Chinese Univ. of Hong Kong, Shatin. Dept. of Geography. R. J. Neller

Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 3, p 167-171, November/ December 1989. 5 fig, 1 tab, 11 ref.

Descriptors: *Catchment areas, *Channel morphology, *Erosion, *Gully erosion, *Stream erosion, *Unstable channels, *Urban hydrology, Australia, New South Wales, Urban runoff.

Surveys of stream channels in 14 small catchments within and adjacent to Armidale, northern New South Wales, revealed that urban affected streams were, on average, four times larger than adjacent rural streams. The enlargement of such channels is frequently attributed to increased urban storm runoff. In this case, however, there is no apparent librace, between the decrea of urban development. runoff. In this case, however, there is no apparent inikage between the degree of urban development and magnitude of channel enlargement. Rather, it appears that gullying is initiated by more direct disturbances to these channel boundaries, such as realignment and the building of road crossings. Once gullying has been initiated the degree of channel enlargement seems to be a function of slope; the enlargement of channels in the steeper headwater urban calculates. headwater urban catchments being significantly greater than that in the lower reaches. For incip-iently unstable channels such as these, the more conventional erosion control measures may be in-adequate. (Author's abstract)

ASSESSMENT OF THE EFFECT OF URBAN DEVELOPMENT ON GRO LEVELS IN A CHALK AQUIFER. DEVELOPMENT GROUNDWATER

University Coll., Cardiff (Wales). School of Engi-

J. C. Miles, J. W. Lloyd, and J. A. J. Witt. Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 3, p 187-194, November/ December 1989. 10 fig, 2 tab, 15 ref.

Descriptors: *Groundwater level, *Mathematical models, *Storm water management, *Urban drainage, *Urban hydrology, *Urban planning, Aquifer characteristics, Groundwater recharge, *Storm

Groundwater levels can be appreciably affected by urban development. Underlying the site of a proposed development is a chalk aquifer. Groundwater levels are close to the surface. The storm water from the development is to be drained into a lake in the center of the development. Because of the high groundwater levels, the effect of this lake has been studied by means of a simple localized mathematical model. The results of the model calibration matical model. The results of the model calibration are encouraging and show that acceptable results can be obtained from relatively simple groundwater flow models for situations where the available data are limited in quality and/or quantity and the use of complex models cannot be justified unless a large amount of time and money are available to invest in data collection. It is possible to use time variant, distributed parameter, numerical models that are simple and easy to formulate and obtain

Effects On Water Of Man's Non-Water Activities-Group 4C

acceptable results. Such models should not be used where accuracy is important but only where an approximate assessment of the aquifer behavior is required. (Author's abstract) W90-06962

SIMULATED EFFECTS OF QUARRY DEWA-TERING NEAR A MUNICIPAL WELL FIELD. Geological Survey, Columbus, OH. For primary bibliographic entry see Field 2F.

MODELING COASTAL LANDSCAPE DYNAM-

Maryland Univ., Solomons. Chesapeake Biological

Bioscience BISNAS, Vol. 40, No. 2, p 91-107, February 1990. 13 fig, 2 tab, 41 ref.

Descriptors: *Coastal environment, *Coastal zone management, *Computer models, *Costs, *Environmental impact, *Geomorphology, *Louisiana, Coastal waters, Erosion, Organic matter, Simulation analysis, Subsidence, Suspended sediments.

Protecting and preserving coastal ecosystems re-quires the ability to predict the direct and indirect, temporal, and spatial effects of proposed human activities, the ability to separate these effects from natural changes, and the ability to appropriately modify the short-term incentive structures that modify the short-term incentive structures that guide local decision-making to better reflect these impacts. To study this, a process-based spatial simulation model was developed for the Atchafalaya-Terrebonne marsh-estuarine complex in south Louisiana called the coastal ecological landscape spatial simulation (CELSS) model. The model consists of 2479 interconnected square cells, each representing 1 square kilometer. Each cell contains a dynamic ecosystem simulation model, and each cell is connected to its four nearest neighbors by dynamic ecosystem simulation model, and each cell is connected to its four nearest neighbors by the exchange of water and suspended materials. The buildup of land or the development of open water in a cell depends on the balance between net inputs of sediments and local organic peat deposition on the one hand and outputs due to erosion and subsidence on the other hand. This balance is critical for predicting how marsh succession and productivity is affected by natural and human activities. The results of the model indicate complex and often counterintuitive behavior that, like the real system, is difficult to summarize. A few generreal system, is difficult to summarize. A few general conclusions can be made, however. Past and future climate variations are important, especially severe deviations from average conditions. Ecological variables, such as primary production, have significant feedback to physical and chemical procsignificant rectoack to physical and chemical proc-esses. Coastal marshes can adapt to future project-ed higher rates of sea level rise and serve as a buffer against future global sea level rise if the rates are moderate and the marshes are healthy. Past activities in the area that modified the hydrologic and sediment flow patterns have had signifi-cant influence on the evolution of the region. And cant intuence on the evolution of the region. And infinally, management options in the area can be effective at mitigating the effects of proposed human alterations, but cumulative effects make analysis of individual options in isolation risky. (Mertz-PTT) W90-07136

IMPACT OF CATTLE ON TWO ISOLATED FISH POPULATIONS IN PAHRANAGAT VALLEY, NEVADA. Nevada Univ., Las Vegas. Dept. of Biological

Great Basin Naturalist GRBNAR, Vol. 49, No. 4, p 491-495, October 1989. 2 fig, 1 tab, 9 ref.

Descriptors: *Ammonia, *Cattle, *Fish popula-tions, *Nevada, *Nitrates, *Water pollution effects, *Water pollution sources, Bacteria, Bacterial anal-ysis, Dace, Fish management, Pathogenic bacteria, Springfish.

As spring systems diminish and human use of land and water increases, endemic fish populations in-creasingly live precariously between threatened and extinct status. In Pahranagat Valley and elsewhere in the West, a prominent cause of this situation involves the management of water for use situation involves the management of water for use by cattle with unrestricted access. The presence of cattle at Brownie Spring and Ash Springs in Pahranagat Valley, Nevada, impacted fish populations by causing an increase in ammonia and nitrate levels, an increase in Pseudomonas aeruginosa and Aeromonas hydrophila, and increased mortality and morbidity. One of the affected fishes, the White River springfish, is listed as endangered by the Department of the Interior. After removal of the cattle from Ash Springs ammonium and nitrite the cattle from Ash Springs, ammonium and nitrite levels decreased and fish populations increased. At levels decreased and hish populations increased. At Brownie Spring, the ammonium and nitrite levels are chronically elevated, cattle are still present, and the speckled dace population has not recov-ered. (Mertz-PTT) W90-071139

EFFECTS OF HOPPER DREDGING AND SEDIMENT DISPERSION, CHESAPEAKE BAY.

BAY. Virginia Inst. of Marine Science, Gloucester Point. W. Nichols, R. J. Diaz, and L. C. Schaffner. Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 1, p. 31-43, January/February 1990. 9 fig. 5 tab, 37 ref. Baltimore District, Corps of Engineers contract DACW-31-87-C-0024.

Descriptors: *Chesapeake Bay, *Dredging, *Environmental effects, *Sediment distribution, *Suspended sediments, *Turbidity, Benthic fauna, Plumes, Water quality.

Plumes, Water quanty.

Hopper dredging operations release suspended sediment into the environment by agitation of the bed and by discharge of overflow slurries. Monitoring of turbidity and suspended sediment concernations in central Chesapeake Bay revealed two plumes: (1) an upper plume produced by overflow discharge and (2) a near-bottom plume produced by draghead agitation and rapid settling from the upper plume. The upper plume dispersed over 5.7 sq km extending 5200 meters form the discharge point. Redeposited sediment accumulated on channel flanks covering an area of 6.4 sq km and reached a thickness of 19 cm. Altogether dredging redistributed into the environment an estimated 100 000 tons of sediment or 12% of the total matereached a thickness of 19 cm. Attogether dreuging redistributed into the environment an estimated 100,000 tons of sediment or 12% of the total mate-rial removed. Near-field concentrations of sus-pended sediment, less than 300 m from the dredge, reach 840-7200 mg/L or 50-400 times the normal background level. Far-field concentrations (>300 background level. Far-field concentrations (>300 m) are enriched 5-8 times background concentrations and persist 34-50% of the time during a dredging cycle (1.5-2.0 h). The overflow discharge plume evolves through three dispersion phases: (1) convective descent, (2) dynamic collapse, and (3) long-term passive diffusion. The bulk of the material descends rapidly to the bottom during the convective descent phase, whereas the cloud that remains in suspension is dispersed partly by internal waves. Although suspended sediment concentrations in the water column exceed certain water column exceed certain water multity standards. benthic communities survived quality standards, benthic communities survived the perturbation with little effect. (Author's abstract) W90-07189

HYDROLOGIC EFFECTS OF CLIMATE CHANGE IN THE DELAWARE RIVER BASIN. Geological Survey, West Trenton, NJ. For primary bibliographic entry see Field 2A. W90-07212

ESTIMATION OF POTENTIAL REDUCTIONS IN RECREATIONAL BENEFITS DUE TO SEDIMENTATION.

State Coll., MD. Perdue School of Busi-

N. Ralston, and W. M. Park.
Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1259-1265, December 1989. 1 fig, 15 ref.

*Economic prediction, *Model studies, *Recreation, *Sedimentation, *Soil conservation, *Water use, Cost analysis, Estimating, Reelfoot Lake, Tennessee, Travelting

A travel cost model was developed to estimate the potential reductions in recreational benefits from sedimentation in Reelfoot Lake in northwestern seumentation in Reentoot Lake in northwestern Tennessee. In addition to the consumer surplus estimates generated by the model, three other as-pects of the study were significant. First, the study applied a relatively untested methodology for deappined a reasovery uncested memorology for civing the opportunity cost of travel time. The study resulted in a value that is less than one-half of the Water Resource Council's 'one-third of the wage rate' rule-of-thumb. Second, water quality wage rate' rule-of-thumb. Second, water quality perceptions were unsuccessfully incorporated into the model as a demand shifter. This raised the question as to the appropriate manner in which perceptions could be included in a travel cost model. Finally, a simple methodology was outlined by which estimates of the recreational value of Reelfoot Lake could be used to suggest how much cost could be justified for soil erosion control on agricultural land surrounding the lake. (Author's abstract) abstract)

CHEMICAL CHARACTERISTICS OF A MEDITERRANEAN RIVER AS INFLUENCED BY LAND USES IN THE WATERSHED,

Barcelona Univ. (Spain). Dept. de Ecologia. For primary bibliographic entry see Field 5B. W90-07415

KANSAS CLEAN LAKES PROGRAM, LAKE OLATHE, CITY OF OLATHE, KANSAS.

OLATHE, CITY OF OLATHE, KANSAS.
Kansas Dept. of Health and Environment, Topeka.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-209951.
Price codes: Al4 in paper copy, A01 in microfiche.
Report prepared for U.S. Environmental Protection Agency, Kansas City, MO, June 1986. 355p,
21 fig., 24 tab, 18 append.

Descriptors: *Environmental effects, *Eutrophication, *Kansen, *Lake Olathe, *Limnology, *Urbanization, *Water pollution control, *Water quality, *Water quality trends, Algae, Chlorophyll, Enrichment, Eutrophic lakes, Industrialization, Lake fisheries, Monitoring, Nutrients, Oxygen depletion, Phosphorus, Septic tanks, Septic wastewater, Urban watersheds.

Under the auspices of the Clean Water Act of 1972, a study was conducted of Lake Olathe for the purpose of determining the nutrient loads eutrophication response relationships for this lake. Of particular concern in this study was the assessment of the impact of urbanization and industrialization of the Lake Olathe watershed on the lake's water of the impact of urbanization and industrialization of the Lake Olathe watershed on the lake's water quality. A thirteen-month (August 1982 to September 1983) monitoring program was conducted on Lake Olathe and its two principal tributaries. It was found that Lake Olathe is a eutrophic lake with concentrations of plantkonic algal chlorophyll during late summer of 1983 in excess of approximately 25 micrograms/L. The normalized P load for this lake, based on the waterbody's mean, depth, area and hydraulic residence time, was such that it is possible to predict the plank-tonic algal chlorophyll, algal-related Secchi depth, and hypolimnetic oxygen depletion rates. Good agreement was found between predicted and measured algal chlorophyll. The hypolimnetic oxygen depletion rates were such that the hypolimnion of this lake became completely deoxygenated by midsummer thereby impairing the development of cold and warm water fisheries. It was found that the small impoundments located in the Lake Olathe watershed significantly removed trapped P derived from land runoff, causing Lake Olathe to have a much higher water quality than would be expected based on the lake' morphological and hydrological characteristics and land use within the lake's watershed. If it were not for the trapping of P by these impoundments, the lake would have much poorer water quality. One of the areas of primary concern is that of the failure of septic tank wastewater disposal systems to function properly in the relatively impervious soils of the watershed. primary concern is that of the nature of septic tank wastewater disposal systems to function properly in the relatively impervious soils of the watershed. It is that further development within the Lake Olathe watershed be done in such a way as to minimize the number of septic tank wastewater disposal system failures. If this is done, then the

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

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projected urbanization of the Lake Olathe watershed over the next 15 years or so will have limited adverse impact on the lake's eutrophication related water quality. (Lantz-PTT) W90-07492

4D. Watershed Protection

FARM INCOME AND GROUND WATER QUALITY IMPLICATIONS FROM REDUCING SURFACE WATER SEDIMENT DELIVERIES. Bureau of Reclamation, Denver, CO. S. Piper, W. Y. Huang, and M. Ribaudo. Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1217-1230, December 1989. 6 fig. 5 tab, 18 ref.

scriptors: *Erosion control, *Farm Descriptors: "Crosson Control, "Farm Income, "Groundwater quality, "Nonpoint pollution sources, "Path of pollutants, "Soil erosion, "Sur-face-groundwater relations, Crop rotation, Leach-ing, Linear programming, Model studies, Pesti-cides, Tillage, Water pollution, Water quality.

The potential surface water and groundwater quality tradeoff implications from the nonpoint source provisions of the 1987 Water Quality Act are inwater Quanty Act are in-vestigated using a national linear programming model developed at Iowa State University and modified by the Economic Research Service and the Leaching Evaluation of Agricultural Chemi-cals (LEACH) Handbook developed by the U.S. Environmental Protection Agency. The linear pro-gramming model is used to maximize net farm evenue using optimal combinations of crop rota-ons and tillage practices for each region of the revenue u U.S. given natural resource constraints. The LEACH handbook is used to determine the relative potential for pesticides to leach below the root zone for different soil types, hydrologic conditions, pesticides used, and tillage practices. The results indicate that imposing a surface water quality erosion constraint aimed at reducing sediment concentrations results in a larger decrease in farm income than imposing a uniform 5 ton per acre per year erosion constraint. Both constraints could result in regional improvement in groundwater quality in some regions of the country while decreasing groundwater quality in other regions. (Author's bstract) W90-07211

RESULTS OF BIOLOGICAL INVESTIGA-TIONS FROM THE LOWER VIRGIN RIVER VEGETATION MANAGEMENT STUDY. Bureau of Reclamation, Boulder City, NV. Lower

Colorado Region.

M. J. Kasprzyk, and G. L. Bryant. n. J. Aasprzys, and G. L. Bryant.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB90-190521.
Price codes: A05 in paper copy, A01 in microfiche.
Report No. REC-ERC-89-2, March 1989. 75p, 25
fig, 17 tab, 90 ref.

Descriptors: *Biological studies, *Ecosystems, *Phreatophytes, *Riparian vegetation, *Tamarisk trees, *Virgin River, *Wildlife management, Birds, Nevada, Revegetation, Rodents, Seasonal variation, Water birds, Wildlife habitats.

The exotic salt cedar (Tamarix chinensis) has been identified as a widespread, dominant phreatophyte along many riparian flood plains in the Western States. Many problems have been documented as a result of the invasion by salt cedar including ex-tremely high water consumption, tendency to concentrate salts, acting as a flood stream impediment, and providing poor wildlife habitat. In 1982, the Lower Virgin River (Nevada) Vegetation Manage-Lower Virgin River (Nevada) Vegetation Management Study was initiated to determine if clearing phreatophyte vegetation and planting less water consumptive species would result in measurable water savings. From June 1982 to December 1983, the value of salt cedar habitat for wildlife was assessed on a 600-acre study site along the Lower Virgin Player, in Navyada Vegetation obsergetaristics. assessed on a docarte study site along ine Lower Virgin River in Nevada. Vegetation characteristics in the salt cedar study area are best described as a monotypic growth of bushy, multistemmed trees possessing little foliage volume above 10 ft and with moderately dense foliage volume at the 6-inch to 2-foot level. Permanent resident bird species

such as the Song Sparrow, Bewick's Wren, and such as the Song Sparrow, Bewick's Wren, and Aberts' Towhee occurred at higher densities throughout all months of the year than the mi-grant, summer breeding, or wintering species. Bird densities in salt cedar were substantially lower when compared to densities found in similar studwhen compared to densities found in similar stud-ies of native riparian habitat. An increase in marsh vegetation within the salt cedar habitat in 1983 enhanced wetland bird species densities. Of the seven species of rodents trapped in salt cedar, House Mouse and Western Harvest Mouse occurred at the highest densitie. Detailed recommendations for maximizing successful revegetation plans were based on prior studies of native plants and agricultural crops. (Author's abstract) W90-07481

CAPITAL LAKE FINAL REPORT.
South Dakota Dept. of Water and Natural Re-

South Dakota Dept. of Water and Natural Resources, Pierre.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-209167.
Price codes: A03 in paper copy, A01 in microfiche. Report prepared for U.S. Environmental Protection Agency, Denver, CO, October 1985. 34p, 1 fig. 5 tab, 14 ref, 2 append. EPA Grant \$008307-01.

Descriptors: *Bank protection, *Capitol Lake, *Erosion control, *Riprap, *Water quality, Aquatic plants, Dredging, Nitrogen, Nutrients, Phosphorus, Pierre, South Dakota, Suspended solids, Wild-

Capitol Lake is a shallow prairie lake located on the State Capitol grounds in Pierre, South Dakota. The lake is a major tourist attraction in the area because of the warm water artesian well flowing into the lake, which contains natural gas ignited in a perpetual flame. Because of warm water associated with the well (34 C), the lake remains open in the winter attracting large concentrations of water-fowl. In 1980 and 1981, the shoreline was ri-prapped to reduce erosion and water level control structures were built to control aquatic macro-phytes. In 1982, the lake was dredged increasing the lake's depth from three feet to ten feet. A monitoring program was initiated before the project began, and continued during and after the project was completed. Because of the nutrients contributed to the lake from the well and from waterfowl scats, a reduction in nutrients (i.e., phos-phorus and nitrogen) was not observed in the lake. A reduction in suspended solids was observed in both the lake and in the tributary to the lake from Hilger's Gulch. This positive impact should serve to extend the life of the lake. (Author's abstract) W90-07493

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

ASPECTS OF THE PHOSPHORUS CYCLE IN HARTBEESPOORT DAM (SOUTH AFRICA), PHOSPHORUS LOADING AND SEASONAL DISTRIBUTION OF PHOSPHORUS IN THE

National Inst. for Water Research, Pretoria (South

For primary bibliographic entry see Field 2H. W90-06585

SEQUENTIAL DECISION PLANS, BENTHIC MACROINVERTEBRATES. AND BIOLOGI-MACROINVERTEBRATES, AND CAL MONITORING PROGRAMS. lifornia Univ., Berkeley. Dept. of Entomologi-

cal Sciences.

cal sciences. J. K. Jackson, and V. H. Resh. Environmental Management EMNGDC, Vol. 13, No. 4, p 455-468, July/August 1989. 2 fig, 9 tab, 43 ref. Univ. of California Water Resources Project UCAL-WRC-W-646.

Descriptors: *Bioindicators, *Data interpretation,
*Macroinvertebrates, *Mathematical models,

*Monitoring, *Species diversity, *Water quality management, Benthic fauna, Mathematical analy-sis, Sequential decision plan, Water quality control.

A common obstacle to the inclusion of benthic A common obstace to the inclusion or bentine macroinvertebrates in water quality monitoring programs is that numerous sample units must be examined in order to distinguish between impacted and unimpacted conditions, which can add significantly to the total cost of a monitoring program. Sequential decision plans can be used to reduce this cost because the number of sample units tins cost occasion in mimor of sample units needed to classify a site as impacted or unimpacted is reduced by an average of 50%. A plan is created using definitions of unimpacted and impacted conditions, a description of the mathematical distribuditions, a description of the mathematical distribution of the data, and definitions of acceptable risks
and type I and type II errors. The applicability of
using sequential decision plans and benthic macroinvertebrates in water quality monitoring programs is illustrated with several examples (e.g.,
identifying moderate and extreme changes in species richness in response to acid mine drainage;
assessing the impact of a crude oil contamination
on the density of two benthic populations; monitoring the effect of geothermal effluents on species
diversity). These examples use data conforming to
the negative binomial, Poisson, and normal distributions and define impact as changes in population
density, species richness, or species diversity based
on empirical data or the economic feasibility of the
sequential decision plan. All mathematical formulae and intermediate values are provided for the lae and intermediate values are provided for the step-by-step calculation of each sequential decision plan. (Author's abstract) W90-06609

HEAVY METAL DETECTION IN THE SEDI-MENT-WATER COMPONENTS OF THE SADO ESTUARY BY MULTIELEMENTAL ANALY-

Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal). M. M. Bordalo Costa, and M. C. Peneda.

Environmental Technology Letters ETLEDB, Vol. 10, No. 7, p 697-705, July 1989. 4 fig, 2 tab, 8

Descriptors: *Heavy metals, *Path of pollutants, *Pollutant identification, *Sado Estuary, *Sediment-water interfaces, Chemical analysis, Environmental impact, Estuaries, Estuarine Sediment contamination.

The complex dynamic process that controls trace The complex dynamic process that controls trace metals distribution in estuarie sediments is linked to the physical and geochemical characteristics of each estuary. When the polluted areas impact upon human activities, these trace metals and other pollutants must be monitored carefully. Heavy metals were analyzed in the sediments and waters of Sado Estuary to estimate the potential environmental impact of industrial and urban discharge into the north channel of the estuary. Chromium, iron, paickel corpus rine mylyddayum areasis asilium. nickel, copper, zinc, molybdenum, arsenic, gallium, mercury, and lead were determined in bottom waters and in surface sediments of the estuary by the PIXE method. A proton beam induced by a two megavolt Van de Graaff acclerator and sub-sequent X-ray emission was used. Sediment concentration factors were evaluated and geographical distribution of some elements in the estuary was shown. These factors reflect the biological availability of each of these elements, and the potential silt/clay sediment enrichment. The PIXE method is sensitive, rapid and reliable for trace metals evaluation of environmental samples. A continuous monitoring program to assess the degree of metal pollution in the estuary would allow for the proposal of remedial measures to minimize damaging effects. (Brunone-PTT) W90-06620

MONITORING OF WATER QUALITY: SEA-SONAL VARIATIONS OF HEAVY METALS IN SEDIMENT, SUSPENDED PARTICULATE MATTER AND TUBIFICIDS OF THE ELBE

Hamburg Univ. (Germany, F.R.). Inst. fuer Hy-drobiologie und Fischereiwissenschaft.

Identification Of Pollutants—Group 5A

For primary bibliographic entry see Field 5B. W90-06626

MULTIPHASE AND MULTICOMPOUND MEASUREMENTS OF BATCH EQUILIBRIUM DISTRIBUTION COEFFICIENTS FOR SIX VOLATILE ORGANIC COMPOUNDS, Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering

vironmental Engineering.
For primary bibliographic entry see Field 5B.
W90-06628

FILTRATION OF GROUND WATER SAMPLES FOR METALS ANALYSIS. Robert S. Kerr Environmental Research Lab.,

R. W. Puls, and M. J. Barcelona. Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 4, p 385-393, Fall 1989. 2

Descriptors: *Filtration, *Groundwater pollution, *Heavy metals, *Pollutant identification, *Sampling, *Water analysis, Aquifers, Iron, Path of

The attachment or incorporation of contaminants to suspended particulates has been proposed as a possible transport mechanism in groundwater. The filtration of groundwater samples with 0.45 micrometer filters for the determination of dissolved metals is not only inaccurate for distinguishing between dissolved and particulate phases, but if used for estimates of mobile contaminant loading in used for estimates of mobile contaminant loading in a given aquifer, may result in significant underesti-mation. Assumptions concerning assessments of colloidal mobility are that the bladder pump, with its low flow rate, permits only naturally suspended particulates to be pumped to the surface. While concentration differences due to different filter concentation unterences due to different filter pore sizes were generally not striking, differences between those samples collected in air and under nitrogen were significant in wells high in iron and with low pH. These inaccuracies make determination of potential heavy metal pollution difficult. (Brunone-PTT)

INDUCTION OF MICRONUCLEI IN GILL TISSUE OF MYTILUS GALLOPROVINCIALIS EXPOSED TO POLLUTED MARINE WATERS. Pisa Univ. (Italy). Dipt. di Scienze dell'Ambi del Territorio.

R. Scarpato, L. Migliore, G. Alfinito-Cognetti, and R. Barale.

Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 2, p 74-80, February 1990. 6 fig, 3 tab, 37 ref.

Descriptors: *Bioassay, *Bioindicators, *Marine environment, *Mussels, *Mutagenicity, *Pollutant identification, Bioaccumulation.

Aquatic pollution results from different sources of contamination, principally due to human techno-logical activities. Large quantities of chemicals are discharged daily into marine environments by indischarged daily into marine environments by in-dustrial and domestic effluents. The micronucleus assay in gill tissue of the mussel Mytilus gallopro-vincialis has been developed in our laboratory to assess the mutagenic activity of compounds present in marine environments. These mussels are easily able to accumulate and concentrate chemical pol-lutants in their tissues. The sensitivity of the test was assessed by performing mutagenic treatment for 48 hours with the two standard compounds vincristine (VCR) (0.005, 0.01, 0.02 mg/L), and benzo(a)pyrene (BaP)(0.25, 0.075,0.225, 0.675 mg/ benzo(a)pyrene (BaP)(0.25, 0.075,0.225, 0.675 mg/L). Since both tested chemicals produced significant increases in the number of micronucleated cells, animals were directly exposed to marine waters: mussels grown in clean water (control sample) were transferred to polluted areas and then collected weekly. Micronuclei frequencies of sampled mussels were significantly higher than the value of the control group. In situ assays, using mussels from a different location, would allow for the monitoring of marine sites in which mussels may not grow spontaneously and for a comparison of mutagenic activity in many different environments. (Author's abstract)

W90-06643

FACTORS INFLUENCING THE UPTAKE OF TECHNETIUM BY THE BROWN ALGA FUCUS SERRATUS.

Institut Royal des Sciences Naturelles de Belgique,

D. van der Ben, M. Cogneau, V. Robbrecht, G.

D. van der Ben, M. Cogneau, V. Robbrecht, G. Nuyts, and A. Bossus. Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 2, p 84-86, February 1990. 4 fig, 10 ref. CEC Contract Nr. B16-0049-B.

Descriptors: *Algal growth, *Bioaccumulation, *Bioindicators, *Fucus, *Radioactive wastes, *Technetium radioisotopes, Chromatography, Temperature.

The brown alga Fucus serratus and other Fucales are considered good bioindicators of radioactive contamination by technetium. However, little incontamination by technicular, roowever, fittle in-formation exists on the main factors which affect uptake of this radionuclide by marine macroalgae. Various experiments on F. serratus, under light, in darkness, at two different temperatures (4 and 20 Of and after heat-inactivation, suggest that the accumulation of technetium is a physiologically controlled process. This hypothesis is supported by chromatographic analyses of algal extracts, in which the proportion of technetium bound to organic molecules was found to be higher under light than in darkness or at 4 C. (Author's abstract) W90-06645

PESTICIDES AND PCBS IN SOUTH CAROLI-

NA ESTUARIES.
Fluor Daniel, Greenville, SC.
For primary bibliographic entry see Field 5B. W90-06643

IDENTIFYING TOXICANTS: NETAC'S TOXIC-ITY-BASED APPROACH.

National Effluent Toxicity Assessment Center, Duluth, MN.

L. P. Burkhard and, and G. T. Ankley. Environmental Science and Technology ESTHAG, Vol 23, No. 12, p 1438-1443, December 1989. 3 fig, 1 tab, 22 ref.

Descriptors: *Pollutant identification, *Water quality standards, *Administrative agencies, *Toxicology, *Water pollution control, *Toxicity, Effluents, Water law, Permits.

Title IV of the Federal Water Pollution Control Act of 1972 describes the National Pollutant Discharge Elimination System (NPDES), which enables chemical and toxicity limits to be set for effluents from point-source dischargers. This is done through permit programs administered either by the EPA or authorized state agencies. In 1984 by the EPA recommended an integrated approach to NPDES permit policy featuring the use of whole-effluent toxicity tests combined with chemical-specific analyses. This is currently the best approach cific analyses. This is currently the best approach for requiring and ensuring compliance with the Clean Water Act, but an integral part of the Toxicity Reduction Evaluations (TREs) is the Toxicity Reduction Evaluation (TIE). The goal of any TIE method is to identify quickly and cheaply those chemicals causing toxicity. For a TIE method to be successful, it must be able to resolve all of the analytical and toxicological problems posed by effluents. The concentration-response curve for the toxicants must be understood, including the influences of the effluents matrix on the curve for the toxicants must be understood, including the influences of the effluents matrix on the toxicants and synergistic and antagonistic interactions among toxicants. The chemical-specific approach expands the priority pollutant monitoring method, but appears to be somewhat impractical for performing cost-effective TIEs. The toxicity-based approach separates the toxicants from the based approach separates the toxicants from the nontoxic components in the effluent prior to performing instrumental analyses. One shortcoming of the conventional TIE approach is that no direct relationship exists between the toxicants and the results of the analytical methods. The EPA's National Effluent Toxicity Assessment Center (NETAC) has recently developed TIE approaches which avoid some of the analytical problems.

These procedures were developed over the past three years for performing TIEs on acutely toxic chemicals. NETAC's TIE approach consists of three phases-toxicant characterization, toxicant dientification, and toxicant confirmation. These TIE methods can be applied to river and lake waters, sediment interstitial waters, and leachates from solid-waste sites, but are not useful for identification. fying chronically toxic compounds. (Male-PTT) W90-06662

LOW-COST, PORTABLE FLOW CYTOMETER SPECIFICALLY DESIGNED FOR PHYTO-PLANKTON ANALYSIS.

University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics. For primary bibliographic entry see Field 7B. W90-06676

DEVELOPMENT OF THE REVISED DRINK-ING WATER STANDARD FOR CHROMIUM. Environmental Protection Agency, Washington, DC. Office of Drinking Water. For primary bibliographic entry see Held 5G. W90-06698

ELIMINATION OF PENTACHLOROPHENOL POLLUTION FROM THE FORTH CATCHMENT.

MEN1.
D. Campbell, and I. M. Ridgway.
Journal of the Institution of Water Engineers and
Scientists JIWSDI, Vol. 3, No. 6, p 599-603, December 1989. 4 fig, 1 tab, 13 ref.

Descriptors: *Fungicides, *Pentachlorophenol, *Phenols, *Water pollution control, *Water pollution sources, Forth River, Pulp and paper industry,

Following adoption of the European Communities Directive 86/280/EEC, three major point sources of pentachlorophenol (PCP) were identified in the Forth River catchment. At least one of these was known to be causing serious water pollution. While methods to determine low concentrations of PCP in the environment were being developed, discussions were held with the dischargers on ways to eliminate PCP from their effluent. Despite the additional costs involved, agreement was ways to eliminate PCF from their effluent. Despite the additional costs involved, agreement was reached on the substitution of alternative, biodegradable fungicides. Although these major polluting discharges of PCP have now been eliminated, background levels of PCP found in rivers in the background levels of PCP round in rivers in the Forth River Purification Board's area show that other minor sources of PCP remain, indicative of the widespread use of this powerful and persistent fungicide. (Author's abstract) W90-06720

TRACE-LEVEL ANALYSIS OF PHTHALATE ESTERS IN SURFACE WATER AND SUSPENDED PARTICULATE MATTER BY MEANS OF CAPILLARY GAS CHROMATOGRAPHY WITH ELECTRON-CAPTURE AND MASS-SELECTIVE DETECTION.

Rijkswaterstaat, Haren (Netherlands). Tidal Waters Div.

Waters 2017.

R. Ritsema, W. P. Cofino, P. C. M. Frintrop, and U. A. T. Brinkman.

Chemosphere CMSHAF, Vol. 18, No. 11/12, p 2161-2175, 1989. 7 fig. 4 tab, 28 ref.

Descriptors: *Esters, *Gas chromatography, *Phthalates, *Pollutant preservation, *Suspended solids, Biodegradation, Particulate matter.

A procedure for the determination of six phthalate esters (PEs) in water and suspended particulate matter involves a liquid-solid extraction followed by gas chromatography-mass selective detection for dissolved PEs, and an acetone/hexane extraction followed by gas chromatography-mass selective detection for PEs in suspended particulate matter. The time needed to isolate PEs from the matrix is 1 hr for the water samples and 0.5 hr for the suspended particulate matter samples. Using a solid-phase extraction, method detection limits of

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0.01 to 0.1 microgm/L could be achieved, while 0.01 to 0.1 microgm/L could be achieved, while method detection limits in suspended particulate matter, using a simple extraction, were 0.01 to 1 mg/kg. The biodegradation of PEs in water was investigated during 10 days at 4 and 20 C. PEs were measured in extracts from river Rhine and Lake Yssel water and suspended particulate matter samples by means of gas chromatography with electron-capture and mass-selective detection. Be-cause of its superior selectivity, the mass-selective detection is recommended for the determination of PEs in environmental samples. A continuous cen-PES in environmental samples. A continuous cen-trifuge is needed for sampling to prevent contami-nation from PEs originating from the filters. Water samples should be stored at 4 C, in order to pre-vent rapid biodegradation of the PEs, and analysis vent rapid olougradation of the Pres, and analysis should take place within 1 week. Suspended particulate matter samples should be stored at -18 C, and can then be kept for at least 1 week, but probably much longer because biodegradation occurs mainly in the water phase. (Geiger-PTT)

CHEMICAL STABILITY OF THE MUTAGENS S-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(SH)-FURANONE (MX) AND E-2-CHLORO-3-(DICHLOROMETHYL)-4-OXO-

BUTENOIC ACID (E-MX),
Abo Akademi, Turku (Finland).
For primary bibliographic entry see Field 5B.
W90-06748

DISTRIBUTION AND FATE OF HALOGENAT-

ED ORGANIC SUBSTANCES IN AN ANOXIC MARINE ENVIRONMENT. Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemis-

For primary bibliographic entry see Field 5B. W90-06749

METHOD FOR THE DETERMINATION OF METHOD FOR THE DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN PROCESSED WASTEWATER AT THE PARTS PER QUADRILLION LEVEL. Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab. N. H. Mahle, L. L. Lamparski, and T. J. Nestrick. Chemosphere CMSHAF, Vol. 18, No. 11/12, p 2257-2261, 1989. 2 tab, 13 ref.

Descriptors: *Chemical analysis, *Dioxins, *Gas chromatography, *Industrial wastewater, *Pollutant identification, *Wastewater analysis, Mass spectrometry.

The isomer specific determination of low level, parts per quadrillion (PPO), 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TcDD) in processed industrial wastewater is accomplished by filtration, Soxhlet-Dean-Stark extraction, and a two step adversary for the party of the party o sorbent cleanup (silica/sulfuric acid and alumina). sorbent cleanup (silica/sulfuric acid and alumina). Identification and quantitation are via a smectic liquid crystal gas chromatography capillary column and low resolution mass spectrometry. The limit of detection is approximately 1 to 2 PPQ with an average Cl3-labelled-2,37,8-TCDD recovery of 77% beginning with an approximate 4 kg wastewater sample. The use of a high surface area, basic alumina adsorbent cleanup step allows 2,37,8-TCDD to clute after all the other TCDD recovery. The smercic liquid crystal gas chromatographs. 4,3,1,6-1CLD to etute after all the other TCDD isomers. The smectic liquid crystal gas chromatography column further ensures that 2,3,7,8-TCDD will not be interfered with by other TCDD isomers. (Geiger-PTT) W90-06750

PRELIMINARY REPORT ON THE ATRAZINE AND MOLINATE WATER SUPPLY CONTAMI-NATED IN ITALY.

Istituto Superiore di Sanita, Rome (Italy). Lab. di Igiene Ambientale.
For primary bibliographic entry see Field 5B.

STREAM LEVELS OF AGRICHEMICALS DURING A SPRING DISCHARGE EVENT. Univ., Lincoln. Conservation

Survey Div For primary bibliographic entry see Field 5B. W90-06752

ACUTE TOXICITY OF DISPERSED FRESH AND WEATHERED CRUDE OIL AND DIS-PERSANTS TO DAPHNIA MAGNA. Toronto Univ. (Ontario). Inst. for Environmental

For primary bibliographic entry see Field 5C. W90-06753

POTENTIAL UNDERESTIMATION OF CHLORINATED HYDROCARBON CONCEN-TRATIONS IN FRESH WATER.
National Water Research Inst., Burlington (Ontar-

National Water Research Branch.

R. J. Maguire, and R. J. Tkacz.
Chemosphere CMSHAF, Vol. 19, No. 8/9, p 12771287, 1989. 3 tab, 25 ref.

Descriptors: *Aldrin, *Chlorinated hydrocarbons, *DDT, *Pollutant identification, *Polychlorinated biphenyls, *Water analysis, Hydrogen ion concentration, Niagara River, Suspended solids.

Significant concentrations of polychlorinated biphenyls (PCBs) and other chlorinated hydrocarbons have been found in dichloromethane extracts of filtered Canadian Niagara River water at pH 12 after the water had been thoroughly extracted at pH 1. In samples from 43 dates in 1985/86, the contribution of the basic extract to the total concentration derived from acidic, basic and suspendcentration derived from actinc, basic and suspend-ed solids extracts ranged from 0% for 31 of these chemicals to 100% for PCBs 15, 114, and 201, aldrin and p.p'-DDT. When the sums of concentra-tions of each chemical found in Niagara River water in the acidic, basic and suspended solids extracts over the 43 sampling dates were them-selves summed, the basic fraction contributed 40% to the total concentrations of all chemicals, and 48% if only PCBs were considered. Experiments with water from another source showed that some PCBs were recovered in dichloromethane extracts of basic filtered water which had previously been thoroughly extracted under either acidic or neutral conditions. These results indicate that concentrations of chlorinated hydrocarbons in Niagara River tions of chlorinated nydrocarbons in Nagara River water determined by extraction solely at neutral pH, the usual technique, may be underestimated. This finding, which may have general applicability to fresh waters, may be the result of a strong association between a fraction of the dissolved ilipophilic chemicals and dissolved organic matter in fresh water, an association that is resistant to organic solvent extraction at acidic or neutral pH, but which is at least partially disrupted by extraction at high pH. (Author's abstract)
W90-06755

FUGACITY AND PHASE DISTRIBUTION OF MIREX IN OSWEGO RIVER AND LAKE ON-TARIO WATERS.
State Univ. of New York at Syracuse. Coll. of

Environmental Science and Forestry.
For primary bibliographic entry see Field 5B.
W90-06756

DISTRIBUTION OF ALIPHATIC, AROMATIC AND CHLORINATED HYDROCARBONS IN MUSSELS FROM THE SPANISH ATLANTIC COAST (GALICIA): AN ASSESSMENT OF POL-LUTION PARAMETERS.

Instituto de Quimica Bio-Organica, Barcelona (Spain). Dept. of Environmental Chemistry. For primary bibliographic entry see Field 5B. W90-06762

USE OF COMPOSITED SAMPLES TO OPTI-MIZE THE MONITORING OF ENVIRONMEN-

TAL TOXINS,

Jyvaeskylae Univ. (Finland). Dept. of Chemistry.

For primary bibliographic entry see Field 5B.

W90-06764

PREPARATION OF AQUEOUS MEDIA FOR AQUATIC TOXICITY TESTING OF OILS AND

OIL-BASED PRODUCTS: A REVIEW OF THE PUBLISHED LITERATURE.

Shell Research Ltd., Sittingbourne (England). Sit-tingbourne Research Centre. For primary bibliographic entry see Field 5C. W90-06766

BENTHIC INVERTEBRATE BIOASSAYS WITH TOXIC SEDIMENT AND PORE WATER. Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife

J. P. Giesy, C. J. Rosiu, R. L. Graney, and M. G.

Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 2, p 233-248, 1990. 7 fig, 7 tab, 69 ref. EPA Contract DL85-002-06.

Descriptors: *Bioassay, *Bioindicators, *Daphnia, *Interstitial water, *Mayflies, *Midges, *River sediments, *Toxicity, Benthic fauna, Benthos, Bio-logical studies, Invertebrates, Lethal limit, Water pollution effects.

The relative sensitivities of bioassays to determine the toxicity of sediments were investigated and three methods of making the sample dilutions required to generate dose-response relationships were compared. The assays studied were: (1)Mi-crotox, a 1-min assay of Photobacterium phosphoreum bioluminescence inhibition by pore water; (2) 48-hr Daphnia magna lethality test in pore water; (3) 10-day subchronic assay of lethality to and reduction of weight gain by Chironomus tentans performed in either whole sediment or pore water; (4) 168-hr acute lethality assay of Hexagenia limbata in either whole sediment or pore water. The three methods of diluting sediments were: (1) extracting pore water from the toxic location and dilution with pore water from the toxic location and dilution with pore water from the control station; tracting pore water from the toxic location and dilution with pore water from the control station; (2) diluting whole sediment from the toxic location with control whole sediment from a reference location, then extracting pore water; and (3) diluting toxic, whole sediment with whole sediment from a reference location, then using the whole sediment in bioassays. Based on lethality, H. limbata was the most sensitive organism to the toxicity of Detroit River sediment. Lethality of D. magna in pore water was similar to that of H. limbata in whole sediment and can be used to predict effects of water was similar to that of H. limbata in whole sediment and can be used to predict effects of whole sediment toxicity to H. limbata. The concentration required to cause a 50% reduction in C. tentans growth (10-day EC50) was approximately that which caused 50% lethality of D. magna (48-hr LC50) and was similar to the toxicity that restricts benthic invertebrate colonization of contaminated sediments. While the three dilution techniques gave similar results in other assays. The dose-response relationships determined by the three dilution techniques would be expected to vary with sediment, toxicant and bioassay type, and the dose-response relationship derived from each technique needs to be interpreted accordingly. (Author's abstract)

ASSESSMENT OF INDUSTRIAL SEWAGE IM-PACTS BY ADENYLATE ENERGY CHARGE MEASUREMENTS IN THE BIVALVE CERAS-TODERMA EDULE.

Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal). Dept. de Estudos de Impacte Industrial.

A. M. Picado, and Y. LeGal.

Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 1-7, February 1990. 5 fig, 1 tab, 15 ref.

Descriptors: *Bioassay, *Bioindicators, *Industrial wastes, *Pulp and paper industry, *Water pollution effects, Adenylate, Adenylate energy charge, Mollusks, Sado River.

Laboratory toxicity tests performed on the bivalve Cerastoderma edule submitted to sublethal concen-Cerastoderma edule submitted to sublethal concen-trations of paper mill effluent revealed significant decreases of adenylate energy charge (AEC), and changes in the total adenylate pool were observed in a 24-hr period even for the lowest concentration of pollutant tested. Field transfer experiments of C.

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edule from a safe zone to polluted areas of the Sado estuary were carried out at two different times of the year. Close proximity to sewage outfall was shown to result in significant decreases in AEC values within 24 hr. One week after transfer, either normal AEC values were found or the organisms died, depending on the location of the sampling station. (Author's abstract)

PERFUSED FISH GILL PREPARATION IN STUDIES OF THE BIOAVAILABILITY OF CHEMICALS.

Uppsala Univ. (Sweden). Dept. of Zoophysiology. P. Part.

Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 106-115, February 1990. 5 fig, 25 ref.

Descriptors: *Bioassay, *Bioavailability, *Cadmi-um, *Fish physiology, *Toxicology, *Water pollu-tion effects, Gills, Halogenated phenols, Hydrogen ion concentration. Path of pollutants. Trout

ton concentration, Path of pollutants, Trout.

The bioavailability of chemicals has received considerable attention in aquatic toxicology, and it is generally agreed that information about bioavailability is lacking in many situations. Here an experimental approach that can be used to assess the bioavailability of chemicals to fish is presented. The gills are the primary uptake site of dissolved chemicals in fish. A perfused gill preparation from rainbow trout is described. The preparation allows direct measurements of the absorption rates of chemicals across the gill epithelium. The use of the preparation in bioavailability studies is exemplified by a study of cadmium availability in different water qualities, by the pH-dependent absorption of hexavalent chromium and by a study on the pH-dependent absorption of halogenated phenols across the gills. (Author's abstract)

AQUATIC SURFACE MICROLAYER CONTAMINATION IN CHESAPEAKE BAY.
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab. For primary bibliographic entry see Field 5B. W90-06803

SURFACE GEOELECTRICS FOR THE STUDY OF GROUNDWATER POLLUTION: SURVEY

Geofyzika N.E., Geologicka, Barrandov (Czechoslovakia).

For primary bibliographic entry see Field 7A. W90-06892

GC/MS IDENTIFICATION OF MUTAGENS IN AQUEOUS CHLORINATED HUMIC ACID AND DRINKING WATERS FOLLOWING HPLC FRACTIONATION OF STRONG ACID

Environmental Protection Agency, Cincinnati,

Delivironmenta Protection Agency, Cincinnat, OH.
W. E. Coleman, J. W. Munch, P. A. Hodakievic,
F. C. Kopfler, and J. R. Meier.
IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 107121, 6 fig. 3 tab, 18 ref.

Descriptors: *Chlorination, *Drinking water, *Humic acids, *Mutagenicity, *Pollutant identification, *Water treatment, Chemical analysis, Disinfection, Dissolved organic carbon, Gas chromatography, Mass spectrometry

Many by-products from the chlorination of humic acid, as a model substrate for dissolved organic carbon in drinking waters, have shown mutagenic activity. Most of the mutagenic activity of chlorin-ated humic acid (CHA) solutions can be traced to ated humic acid (CHA) solutions can be traced to the strong acid fraction. Diethyl ether extracts of these strong acid fractions of CHA were further fractionated using high-pressure liquid chromatog-raphy (HPLC) separation. Gas chromatography/ mass spectrometry (GC/MS) analyses using fused silica capillary GC columns were performed on the mutagenic high-pressure liquid chromatography

(HPLC) subfractions of CHA and drinking water samples of three U.S. cities. Isolation, fractionation, and derivatization techniques in conjunction with high resolution capillary column GC/MS analysis have proven to be valuable tools in characterizing mutagenic activity in CHA solutions and in drinking waters. In spite of improvements in these chemical techniques, it will become necessary in future work to use more advanced MS techniques in order to analyze these highly polar. techniques in order to analyze these highly polar and labile constituents directly and quantitatively. The identification of disinfection by-products that are important contributors to the mutagenic activity of drinking water should provide a way of ranking chemicals for further testing in the more expensive animal carcinogenesis bioassays that are currently used to develop regulatory standards for carcinogens. Results indicate that source waters containing significant humic materials produce, when chlorinated under drinking water treatment conditions, many of the same types of mutagenic compounds that are found in CHA solutions. (See also W90-06906) (Fish-PTT) W90-06915

APPLICATION OF CLOSED LOOP STRIP-AFFLICATION OF CLUSED LOOP STRIP PING AND XAD RESIN ADSORPTION FOR THE DETERMINATION OF OZONE BY-PRODUCTS FROM NATURAL WATER. California Univ., Los Angeles. For primary bibliographic entry see Field 5F. W90-06922

MICROBIOLOGY OF GRANULAR ACTIVATED CARBON USED IN THE TREATMENT OF DRINKING WATER. Montana State Univ., Bozeman. Dept. of Microbi-

Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, A. K. Camper, D. G. Davies, S. C. Broadaway, and M. W. LeChevallier.
IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 243-254, 2 fig, 2 tab, 36 ref. U.S. Environmental Protection Agency, Drinking Water Research Division Grant No. CR 810015.

Descriptors: *Activated carbon, *Bacterial analysis, *Drinking water, *Granular activated carbon, *Microbiological studies, *Water treatment, Adsorption, Bacterial toxins, Carbon filters, Chemical wastes, Chlorine, Coliforms, Colonization, Disinfection, Enteric bacteria, Flow rates, Heterotrophic bacteria, Pathogenic bacteria, Plankton, Water quality.

The increasing use of drinking water treatment practices utilizing activated carbon has prompted interest in the microbiology of this material, since the same properties that make it an ideal medium for the adsorption of a wide range of chemicals from drinking water also promote the colonization and growth of many types of bacteria on granular activated carbon (GAC) and powdered activated carbon (PAC). A four-year study of the microbiology of GAC in drinking water was performed, in which treated water was sampled from nine operating drinking water systems to test for colonized which treated water was sampled from nine operating drinking water systems to test for colonized GAC particles following carbon filtration. Operational variables were examined to determine if they could be manipulated to minimize bacterial breakthrough or the colonization of GAC filters, and the colonization, growth, and persistence of enteric pathogenic bacteria on GAC were measured. It was found that conventional enumeration procedures underestimate GAC-attached bacterial propulations. Heterotrophic plate count (HPC) and populations. Heterotrophic plate count (HPC) and coliform bacteria colonize operational GAC filters, coliform bacteria colonize operational GAC filters, and populated particles are released even from properly maintained filters. Penetration of populated carbon fines through the treatment barriers was related to increased flow rate, bed depth of GAC filters, and decreased applied water quality. GAC-attached bacteria were not susceptible to chlorine levels commonly used to disinfect potable water. Enteric pathogens can colonize GAC and persist for a varied amount of time depending upon the indigenous HPC population present. GAC-associated coliform bacteria exhibit a greater growth rate and other physiological indices than their planktonic counterparts. (See also W90-06906) (Fish-PTT) W90-06925

APPLICATION OF GENE PROBES TO THE DETECTION OF GROUNDWATER. ENTEROVIRUSES

Arizona Univ., Tucson. Dept. of Microbiology and

Immunology.

A. B. Margolin, K. J. Richardson, R. DeLeon, and C. P. Gerba. IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 265-

270, 4 tab. 9 ref.

Descriptors: *Enteroviruses, *Genetic engineering, *Groundwater pollution, *Pollutant identification, Assay, Culturing techniques, DNA, Drinking water, Economic aspects, Heat treatment, Incuba-

Rapid and low-cost methods for the detection of enteric viruses in water have been sought by water virologists for many years. The currently-used assay system has several drawbacks: long incubation periods, the lack of one cell line that will permit the replication of all enteric viruses, the fact that some enteric viruses such as hepatitus A virus do not exhibit cytopathogenic effects in cell culture, and the high expense of cell culture. Current advances in DNA technology using gene probes now provide a method for identifying the genes of any organism, such as enteric viruses. Poliovirus type 1 and hepatitus A virus strains were grown and assayed. Two different cDNA probes were used for enterovirus detection. Prehybridizations Rapid and low-cost methods for the detection of used for enterovirus detection. Prehybridizations and hybridizations were carried out, then samples were centrifuged and extracted. Results showed were centificated in the plaque-forming and hepatitis A virus were detected in seeded tap water with sensitivities equal to the plaque-forming unit (PFU) and radioimmuno focus assay (RIFA) methods. Beef extract, which was used to elute viruses from filters, did not seem to interfere with the sensitivity of the assay nor did it create false positive results. Heat treatment of the samples seemed to increase the sensitivity of the samples seemed to increase the sensitivity of the assay. The gene probe assay does not first require virus growth in cell culture, decreasing the assay time. It also allows for the detection of viruses that may not be infectious, but still retains their genome. This test is ideal for untreated groundwater used for drinking water, because it can screen many samples in a short time to determine if virus is present. The gene probe assay is more rapid and sensitive than cell culture, and will reduce the cost of testing water. (See also W90-06906) (Fish-PTT) W90-06927

ENVIRONMENTAL CHEMISTRY AND TOXI-COLOGY OF ALUMINUM. For primary bibliographic entry see Field 5B. W90-06929

COORDINATION CHEMISTRY AND SPECIA-TION OF AL(III) IN AQUEOUS SOLUTION. Texas A and M Univ., College Station. Dept. of

For primary bibliographic entry see Field 7B.

SPECIATION METHOD FOR PARTITIONING MONONUCLEAR AND POLYNUCLEAR ALUMINUM USING FERRON.
Oak Ridge National Lab., TN. Environmental Sci-

P. M. Jardine, and L. W. Zelazny. IN: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan.

1989. p 19-40, 11 fig, 5 tab, 53 ref. Descriptors: *Aluminum, *Chemical speciation, *Geochemistry, *Nucleation, *Pollutant identification, *Separation techniques, *Water analysis, *Water chemistry, Chemical analysis, Fulvic acids,

Kinetics, Organic acids, Organic compounds, Sto-chastic models.

Determination of the relative phytotoxicity of the various aluminum (Al) forms to plants and aquatic life requires accurate speciation methods for chem-

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ical partitioning of aqueous Al into its inorganic and organic, mononuclear and polynuclear forms. A method is introduced that eliminates the arbitrary separation of mononuclear and polynuclear Al by modeling the differential kinetic reactions of ferron with partially neutralized inorganic and organic Al solutions. Stock solutions were prepared and preactified. Diluted AlCI3 solutions were also mixed with various quantities of NaF and known quantities of various organic acids. Ten-milliliter aliquots of the Al anion solutions were then partially neutralized. The slow rate of base addition resulted in metastable mixtures of mononuclear and polynuclear Al with no precipitated Al or small quantities of precipitated Al. The interaction of ferron with the unneutralized and partially neutralized Al inorganic and organic solutions, the interaction of Al with fulvic acid, and the fraction of Al complexed by the various organic and inorganic anions were investigated. It was concluded that distinction of mononuclear and polynuclear Al in solutions containing the various anions is possible using ferron if the ligand composition of the solutions is known. Arbitrary separation of mononuclear and polynuclear Al in solutions of Al based on differential kinetic reactions with ferron. Mononuclear and polynuclear Al solutions were described with two simultaneous second-order reactions. (See also W90-06929) (Fish-PTT) W90-06931

STABILITY OF ALUMINUM SPECIES IN A NATURAL AUDIT SAMPLE: POSSIBLE APPLICATION AS A QUALITY CONTROL SOLUTION.

Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. For primary bibliographic entry see Field 5B. W90-06932

CHARACTERIZATION AND TREATMENT OF BY-PRODUCT WATERS FROM SELECTED OIL SHALE RETORTING TESTS.

University of Wyoming Research Corp., Laramie. Western Research Inst. For primary bibliographic entry see Field 5D. W90-06958

ENVIRONMENTAL INFLUENCE OF A VOLCANIC PLUME, A NEW TECHNIQUE OF STUDY, MOUNT ETNA, SICILY.

Luton Coll. of Higher Education (England). Dept. of Science.

of Science.
G. Notcutt, and F. B. M. Davies.
Environmental Geology and Water Sciences
EGWSEI, Vol. 14, No. 3, p 209-212, November/
December 1989. 2 fig. 10 ref.

Descriptors: *Bioindicators, *Heavy metals, *Lichens, *Mt Etna, *Plumes, *Trace elements, *Volcanoes, Acid rain, Rainfall, Sampling.

Detailed study of the chemistry of volcanic plume has previously been hindered by the difficulties of sampling, particularly if data of trace elements are required. In an attempt to overcome this problem and to learn about the regional effects of the plume of Mt. Etna, it was decided to investigate whether lichens, which are used as indicators of aerial pollution, would be suitable for this type of study. Samples collected from the slopes of Etna were assayed, mainly for heavy metals. The results show that this technique has great potential, that lichens can be used to determine semiquantitatively the minor and trace element composition of the plume, and that they can detect the influence of the plume on the chemistry of local rainfall. (Author's abstract)

DILUTION MIXING ESTIMATES OF TRACE METAL CONCENTRATIONS IN SUSPENDED SEDIMENTS.

Maryland Univ., College Park. Dept. of Geography.

W. A. Marcus. Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 3, p 213-219, February 1989. 5 fig, 2 tab, 20 ref.

Descriptors: *Estimating equations, *Monitoring, *Path of pollutants, *Pollution load, *Sediment discharge, *Suspended sediments, *Trace metals, Channels, Model studies.

Dilution mixing equations, at first glance, appear to provide an easy and useful approach for estimating pollutant loads in sediments of unmonitored stream channels. Results from Left Hand Creek, Colorado, however, indicate that only under proper circumstances can dilution mixing models be used to estimate suspended metal concentrations in unmonitored channels with any accuracy. The utility of this technique is severely limited by errors at monitored sites in measuring metal concentrations within sediments and sediment discharge. Specifically, three general constraints must be met before making dilution mixing estimates of unmonitored concentrations: (1) estimated sediment discharges in an unmonitored tributary should be at least 30 percent of that in the main channel below the confluence; (2) there must be a significant difference between the estimated or monitored metal load in the channel below the confluence and the metal loads of the upstream channels; and (3) travel times between the monitoring sites must be incorporated within the calculations. (Author's abstract)

DETERMINATION OF TRACE LEVELS OF HERBICIDES AND THEIR DEGRADATION PRODUCTS IN SURFACE AND GROUND WATERS BY GAS CHROMATOGRAPHY/IONTRAP MASS SPECTROMETRY.

WATERS BY GAS CHROMATOGRAPHI/ION-TRAP MASS SPECTROMETRY. Geological Survey, Denver, CO. W. E. Pereira, C. E. Rostad, and T. J. Leiker. Analytica Chimica Acta ACACAM, Vol. 228, No. 1, p 69-75, January 1, 1990. 2 fig, 2 tab, 23 ref.

Descriptors: *Gas chromatography, *Herbicides, *Mass spectrometry, *Pollutant identification, *Water analysis, Gas chromatography/ion-trap mass spectro, Mississippi River, Trace levels.

A rapid, specific and highly sensitive method is described for the determination of several commonly used herbicides and their degradation products in the surface and ground waters by using gas achromatography/ion trap mass spectrometry. The compounds included atrazine, and its degradation products, desethylatrazine and deisopropylatrazine; simazine; cyanazine; metolachlor; and alachlor and its degradation products, 2-chloro-2;/6-diethylacetanilide and 2,6-diethylaniline. The method was applied to surface-water samples collected from its different stations along the Mississippi River and its major tributaries, and ground water samples beneath a cornfield in central Nebraska. Average recovery of a surrogate herbicide, terbuthylazine, was greater than 99%. Recoveries of the compounds of interest from river water spiked at environmental levels are also presented. Full-scan mass spectra of these compounds were obtained on 1 ng or less of analyte. Data were collected in the full-scan acquisition mode. Quantitation was based on a signal-to-noise ratio of greater than 10:1. (Author's abstract)

DETERMINATION OF HYPOCHLORITE IN WATERS BY STOPPED-FLOW CHEMILU-MINESCENCE SPECTROMETRY. Cordoba Univ. (Spain). Dept. of Analytical Chem-

istry. D. Gonzalez-Robledo, M. Silva, and D. Perez-

Analytica Chimica Acta ACACAM, Vol. 228, No. 1, p 123-128, January 1, 1990. 3 fig, 2 tab, 9 ref. CICYT Grant PB-87-0821.

Descriptors: *Analytical methods, *Chemical analysis, *Hypochlorites, *Luminescence, *Pollutant identification, *Spectrometry, *Water analysis, Bleaching wastes, Chemiluminescence, Disinfection, Stopped-flow technique.

Hypochlorite is used on a large scale in the chlorination of water supplies to destroy or deactivate disease-producing microorganisms, a bleach in laundering and in the pulp and textile industries. The reaction of hypochlorite with luminol was investigated by stopped-flow chemiluminescence spectrometry. The emission was observed by using a conventional fluorescence detector with its shutter off and set at 425nm. Methods based on direct rate measurements on the formation and decay steps of the chemiluminescence process were used in addition to those involving conventional peak-height or peak-area measurements, which were evaluated comparatively. The methods yield linear responses over three orders of magnitudes with an relative standard deviation of about 1%. The proposed method, which is highly selective and rapid (80 samples / h), was applied to the routine determination of hypochlorite in waters. The results were in good agreement with those obtained by the classical N,N-diethyl-p-phenylenediamine spectrophotometric method. (Author's abstract)

FLOW-INJECTION ULTRAVIOLET SPECTRO-PHOTOMETRIC DETERMINATION OF SUL-PHATE IN NATURAL WATERS,

Warsaw Univ. (Poland). Dept. of Chemistry. A. Kojlo, J. Michalowski, and M. Trojanowicz. Analytica Chimica Acta ACACAM, Vol. 228, No. 2, p 287-292, January 15, 1990. 4 fig, 2 tab, 17 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Pollutant identification, *Spectrophotometry, *Sulfates, *Water analysis, Natural waters, Poland, Rivers, Ultraviolet spectrophotometry.

The widespread industrial use of sulfuric acid makes the determination of sulfate important for nenvironmental protection. A sulfate-detection method, based on measurement of the absorbance of the FeSO4(+) complex cation at 355 nm, is proposed. In a single-line manifold with 100-microliter sample injections and the carrier solution at 0.5 ml/min, the peak height vs concentration relationship was linear for 25-100 ml/L sulfate, but the peaks corresponding to FeSO4(+) were preceded by negative peaks. This behavior was not observed when a two-line manifold was used; the iron(III) complexing reagent was injected into a carrier stream (perchloric acid at the same concentration as in the complexing reagent) that was merged with the sulfate-containing sample stream. Calibration graphs were linear in the ranges 25-600 and 10-150 mg/L sulfate, respectively. These optimized conditions, with sample injection and reagent injection, were applied for the determination of sulfate in samples collected from different rivers in the Bialystok district in north-east Poland. The main interference was from ultraviolet-absorbing organic compounds in the sample waters. Such compounds are most effectively removed by using a charcoal column; the results thus obtained were consistent with those from the standard gravimetric method for both types of flow-injection procedure. The pretreatment is time-consuming, and the real sample-throughput rate was about 10/hr. Satisfactory results, only slightly worse than those obtained with the charcoal column, were obtained with the charcoal column, were obtained with and without iron(III) ions were used. Sample throughput was then about 30/hr. (Author's abstract) W90-06989

INVESTIGATION AND REMEDIATION OF VOCS IN SOIL AND GROUNDWATER,

Delta Environmental Consultants, Inc., Fort Collins, CO.
J. M. Kerr.

Environmental Science and Technology ESTHAG, Vol. 24, No. 2, p 172-173, February 1990.

Descriptors: *Cleanup, *Groundwater pollution, *Pollutant identification, *Site remediation, *Soil gases, *Volatile organic compounds, *Water pollution treatment, Data interpretation, Data requirements, Groundwater, Soil treatment.

Identification Of Pollutants-Group 5A

Background data are the key to determining the response when volatile organic compounds (VOCs) are released to the environment. Typically, three levels of data are evaluated: site-specific, local and regional. Information obtained during the background data search should be sufficient to background data search should be sufficient to determine the preliminary objectives, indicate techniques to be used during the investigative phase, provide insight into fate and transport mechanisms, delineate possible risks to human health and the environment, and provide a basic understanding of remedial goals based on local and regional land use. Limited resources can be used best when the investigation and remediation of VOC contamination are based on sound data and realistic phicetures. (A certice VETT. realistic objectives. (Agostine-PTT) W90-06991

SEDIMENTARY COPROSTANOL AS AN INDEX OF SEWAGE ADDITION IN SANTA MONICA BASIN, SOUTHERN CALIFORNIA. California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.

M. I. Venkatesan, and I. R. Kaplan.

Environmental Science and Technology ESTHAG, Vol. 24, No. 2, p 208-214, February 1990. 5 fig. 4 tab, 37 ref. DOE, OHER, Ecological research Division Grant DE-FG03-85-ER60338.

Descriptors: *Marine pollution, *Pollutant identification, *Pollution index, Biogenic sterols, California, Coprostanols, Fate of pollutants, Fecal sterols, Santa Monica Basin, Sediment and Wastewater disposal, Water pollution sources.

Sediment cores from Santa Monica Basin and efflu-Sediment cores from Santa Monica Basin and effluent from two major municipal wastewater dischargers in Southern California were analyzed for sterols. Specifically, fecal sterols, coprostanols (coprostanol and epicoprostanol), were measured to determine the degree of sewage addition to the sediment. Although coprostanols are distributed throughout the Santa Monica Basin sediments in association with fine particles, some stations contain elevated levels, either due to their proximity to the outfalls or because of preferential advection of tam elevated levels, either due to their proximity to the outfalls or because of preferential advection of fine-grained sediments into their location where anoxicity aids in better preservation. The progres-sive seaward decline of coprostanols relative to total sterols from the outfalls represents dilution of sewage by biogenic sterols. The ratio of coprostan-olate time to the steril progression of the composition of the comp ols to dinosterol appears to be a better indicator of sewage addition. A rapid increase in content of coprostanols from 1935 coincides with the start of cophostation and the state of offshore wastewater discharge by the Los Angeles County and City Sanitation Districts on Palos Verdes Shelf. It is estimated that wastewater treatment plants release into southern California Bight 260 metric tons/yr of fecal sterols and 50,000 metric tons/yr of sewage carbon. (Author's abstract) W90-06992

CONTINUOUS DETERMINATION OF RESID-UAL CHLORITE IN WATER. Compagnie Intercommunale Bruxelloise des Eaux

(Belgium). For primary bibliographic entry see Field 5F. W90-06999

WELL-PURGING CRITERIA FOR SAMPLING PURGEABLE ORGANIC COMPOUNDS.

Geological Survey, Trenton, NJ. J. Gibs, and T. E. Imbrigiotta. Ground Water GRWAAP, Vol. 28, No. 1, p 68-78, January/February 1990. 4 fig, 5 tab, 23 ref.

Descriptors: *Groundwater pollution, *Ground-water quality, *Organic compounds, *Organic pol-lutants, *Pollutant identification, *Sampling, *Test wells, *Water sampling, *Well purging, Chlorides, Flushing, Pump wells, Unconsolidated aquifers, Well casings.

Groundwater sampling protocols generally recommend that a well be purged prior to sampling. This recommendation is based on the assumption that the water quality of the water standing in the casing is not the same as that in the aquifer. Three criterior that have been used to determine when a criteria that have been used to determine when a

well has been purged sufficiently to yield 'representative' water quality samples are (1) flushing an arbitrary number of casing volumes, usually a minimum of three, (2) flushing the well until field water quality characteristics-temperature, pH, specific conductance, and disolved oxygen—in the purge water are stable, and (3) flushing until hydraulic equilibrium between casing water and aquifer water is achieved. The effectiveness of these criticals are sufficiently for the stable period of the conductance of the conduct ria in sampling for purgeable organic compounds were evaluated. Wells, screened in unconsolidated were evaluated. Wells, screened in unconsolidated sand and gravel aquifers at six sites, were sampled during a total of 10 purgings. The discharge from each well and the field characteristics were monitored as a function of time and number of casing volumes flushed. Grab samples for purgeable organic compounds, chloride, and ultraviolet absorbance at 254 nanometers wavelength were taken each time a set of field measurements was taken. The variation of field characteristics, purgeable organic compounds, chloride, and ultraviolet absorbance at 254 nanometers was compared with time and number of casing volumes flushed. (Author's abstract) thor's abstract)

IMPORTANCE OF BIOASSAY VOLUME IN TOXICITY TESTS USING ALGAE AND AQUATIC INVERTEBRATES.

Nova Scotta Agricultural Coll., Truro. Environ-mental Microbiology Lab. For primary bibliographic entry see Field 5C. W90-07029

CALMODULIN CONCENTRATION IN MUCUS OF RAINBOW TROUT, SALMO GAIRDNERI, EXPOSED TO COMBINATIONS OF ACID, ALUMINUM, AND CALCIUM.

Lockheed Engineering and Sciences Co., Inc., Las For primary bibliographic entry see Field 5C. W90-07033

SPONGES AS POLLUTION-BIOMONITORS AT ARRAIAL DO CABO, SOUTHEASTERN BRAZIL. Universidade Federal do Rio de Janeiro (Brazil).

Inst. de Biologia

Inst. de Biologia. G. Muricy. Revista Brasileira de Biologia RBBIAL, Vol. 49, No. 2, p 347-354, May 1989. 4 fig, 3 tab, 21 ref.

Descriptors: *Bays, *Bioindicators, *Brazil, *Marine pollution, *Pollutant identification, *Sponges, Domestic wastes, Oil pollution, Species diversity, Wastes, Water quality.

diversity, Wastes, Water quality.

The relation between numerical parameters of the structure of sponge community and water quality at three sites at Arraial do Cabo, Brazil were analyzed. Water quality analysis included temperature, salinity, pH, water transparency, coliform and oil quantification. Quantitative samples were taken by SCUBA diving along transects, which were subdivided into 10 quadrants, one square meter each. The following community parameters were calculated: number of species, species abundance and dominance, area percentile covered by the community, density of individuals, Diversity of species and Evenness indexes. With the exception of Evenness index, all community indexes showed decreased values at the polluted site. The most common species in the area were Mycale microsigmatosa, Amphimedon viridis, Tendana ignis, Aplysina fistularis, Ulosa ruetzleri and Chondrilla monitoring. Analysis of species distribution and of specific similarity between stations reinforces the hypothesis that domestic wastes and oil wastes create quantifiable alterations on the structure of sponge communities at the polluted site, even with sponge communities at the polluted site, even with low pollutant levels. The analysis of numerical tow pollutant levels. The analysis of numerical indexes of community structure and of the local distribution of sponge species on polluted areas may be used as a good model for environmental monitoring. (Author's abstract)

APPLICATION OF THE SO-CALLED MODI-FIED DRAGENDORFF REAGENT TO THE DE-

TERMINATION OF CATION-ACTIVE SUR-FACTANTS IN THE AQUATIC ENVIRON-MENT (ZUR ANWENDUNG DES SOG. MODI-FIZIERTEN DRAGENDORFF-REAGENSES BEI DER BESTIMMUNG VON KATIONTENSI-DEN IM AOUATISCHEN MILIEU).

Bundesanstalt fuer Gewaesserkunde, (Germany, F.R.). H. Hellmann.

Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 335, No. 3, p 265-271, October 1989. 10 fig, 4 tab, 11 ref. English summary.

Descriptors: *Chemical analysis, *Detection limits, *Detergents, *Pollutant identification, *Surfactants, *Water analysis, Cations, Dispersants, Reagents, Sediment contamination.

Cation active surfactants of the distearyl-dimethyl-ammonium chloride type are precipitated, just as the anionic surfactants used in detergents, by the so-called modified Dragendorff reagent. However, only the cation-active surfactants dissolve in CHCl3 and CCl4 to form a colored compound. CHCI3 and CCI4 to form a colored compound. Thus, they can be determined in spectrophotome-trically. The reagent was tested under different conditions for its suitability and was then modified for the cation-active surfactants in a problem-oriented manner. At the same time, the determination limit could be improved by the factor of 5 to 10 by using both derivative spectroscopy and back-cor-rection. Cation-active surfactants can be quantita-tively determined in wastewater, lightly contamitively determined in wastewater, lightly contaminated nated sediments, as well as in heavily contaminated sewage sludges. (Author's abstract)
W90-07083

FAB MASS SPECTROMETRY OF SULPHON-ATED DYES, APPLICATION TO WATER ANALYSIS.

Aigues de Barcelona (Spain).

F. Ventura, A. Figueras, J. Caixach, D. Fraisse,

Analytische Chemie Zachschu, Vol. 335, No. 3, p 272-278, October 1989. 6 fig, 2 tab, 17 ref.

Descriptors: *Azo dyes, *Chemical analysis, *Detection limits, *Dyes, *Mass spectrometry, *Pollutanti identification, *Water analysis, Nitrates, Organic compounds, Trace elements.

Several commercial dyes (nitro, azo, disazo, tri-sazo, oxazine and anthraquinone), ranging from sazo, oxazine and anthraquinone), ranging from mono to trisulfonated compounds, were analyzed by fast atom bombardment (FAB) mass spectrometry. Glycerol and dithiothreitol + dithioerythritol (5:1) gave the best results for the analysis of these dyes and their additives, respectively. (M + Na)(+) ions, cleavage of azo groups, loss of sulfonate from (M + H)(+) or (M + Na)(+) ions were the fragments most commonly observed. Detection limits of some dyes spiked to real water extracts were determined to evaluate their notenextracts were determined to evaluate their poten-tial application to the identification of organic pol-lutants in water. The study showed the potential application of FAB mass spectrometry to analyze anic micropollutants in water not amenable to GC/MS, although the obtained results with dyes are less informative than those for the characterizaare less informative than those for the characteriza-tion of surfactants. The behavior of the studied dyes varies widely. Some of them failed to give interpretable spectra, whereas others gave excel-lent response. Cationized molecular ions, cleavage of azo groups and loss of sulfonate from protonat-ed or cationized molecular ions are the major common features, although it seems that no general some of the studied dyes could be identified in some of the studied dyes could be identified in water in the range of several nanograms or low micrograms, both depending on their chemical structure and potentially interfering compounds present in samples. (Author's abstract) W90-07084

PHOSPHATASE ACTIVITY OF WATER AS A PARAMETER OF THE RIVER TISA WATER MONITORING.

Novi Sad Univ. (Yugoslavia). Inst. of Biology. M. Matavulj, S. Gajin, M. Erbeznik, M. Bokorov,

Group 5A-Identification Of Pollutants

and O. Petrovic. Tiscia TSCAB8, Vol. 23, p 29-36, 1989. 5 fig, 1 tab, 17 ref.

Descriptors: *Bacterial physiology, *Bioassay, *Enzymes, *Eutrophication, *Phosphatases, *Pol-lution index, *Surface water, *Tisza River, *Water pollution, Heterotrophic bacteria, Planktonic bacteria, Statistical analysis.

Investigation of metabolic activity has been Investigation of metabolic activity has been in-creasingly used to assess both trophic level and the degree of pollution of aquatic ecosystems. The results of microbiological and enzymological ex-amination of five localities in the Yugoslav part of the Tisa River are presented for the years 1983-1986. Classical microbiological parameters, such as total number of planktonic bacteria, number of heterotrophic bacteria and T/H index of saprobity (the ratio between the total number of planktonic bacteria and the number of heterotrophic bacteria) (the ratio between the total number of planktonic bacteria and the number of heterotrophic bacteria) which are conventionally used as indicators of the pollution level of surface freshwaters, were compared with the index of phosphatase activity, a new indicator of the degree of eutrophication. A statistically significant correlation between classical microbiological and the new biochemical indicator of organic load of the Tisa River confirms that the phosphatase activity index is a reliable and valid parameter for ovice preliminary estimation of valid parameter for quick preliminary estimation of the degree of pollution in surface freshwaters. (Author's abstract) W90-07112

DOMINANT BACTERIOFLORA IN THE WATER OF THE RIVER TISA AND THE MRTVA TISA (YUGOSLAVIA).

Novi Sad Univ. (Yugoslavia). Inst. of Biology. S. Gajin, M. Gantar, M. Matavulj, Z. Obrecht, and M. Erbeznik

Tiscia TSCAB8, Vol. 23, p 37-42, 1989. 3 fig, 1 tab,

Descriptors: *Aquatic bacteria, *Bioassay, *Bioindicators, *Species composition, *Water quality, Culture media, Culturing techniques, Microflora, Nutrient availability, Tisza River.

During 1987, the dominant microflora of the river During 1987, the dominant microflora of the river Tisa and the Mrtva Tisa was investigated. The bacterioplankton more abundant on diluted agar nutrient media. The use of microbiological param-eters of surface water quality should include the determination of the dominant (i.e. oligotrophic) determination of the dominant (i.e. oligotrophic) microflora of surface waters. This component of bacterioplankton both per se and in relation to viable count gives important information about surface water quality. It is suggested that when determining microbiological indicators of water quality using laboratory methods, diluted nutrient agar media should be used which maintain the oligotrophic microflora. (Brunone-PTT) W90-07113

SNOWFALL CHEMISTRY COLLECTOR IN-TERCOMPARISON TEST (SCCIT). Argonne National Lab., IL. Environmental Re-search Div.

For primary bibliographic entry see Field 7B. W90-07133

ASSESSMENT OF STABLE NITROGEN ISO-TOPES IN FINGERPRINTING SURFACE WATER INORGANIC NITROGEN SOURCES, Louisiana State Univ., Baton Rouge. Nuclear Science Center.
C. W. Lindau, R. D. Delaune, W. H. Patrick, and

E. N. Lambremont. Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 3/4, p 489-496, November 1989. 2 fig, 2 tab, 18

Descriptors: *Isotope studies, *Louisiana, *Nitro-gen compounds, *Pollutant identification, *Surface water, *Water pollution sources, Flow velocity, Industrial wastewater, Municipal wastewater, Wastewater pollution.

In many coastal areas of Louisiana, surface water is deteriorating due to elevated nutrient

input from agricultural, domestic, and industrial sources. A study investigated the potential use of natural abundance variations in nitrogen-15/nitro-gen-14 ratios for identifying and tracing surface water inorganic nitrogen sources. Surface water samples were collected from streams and point sources in Louisiana and analyzed for ammonium. sources in Louisiana and analyzed for ammonium, nitrate nitrogen and associated nitrogen-15/nitrogen-14 concentrations. Ammonium-nitrogen from domestic sewage and industrial discharge point sources was found to have distinct nitrogen-15 sources was found to have distinct nitrogen-15 ranges. Domestic sewage discharge in a slow flowing stream was traced for about 30 kilometers downstream using nitrogen-15/nitrogen-14 ratios. In a larger stream with a greater flow velocity the ammonium/nitrogen-15 surface water signature of an industrial discharge source was identifiable for approximately one kilometer from the point source. The discrete ammonium/nitrogen-15 signatures of domestic sewage and industrial point sources compared to downstream surface water ammonium/nitrogen-15 values sugerest that nitrosources compared to downstream surface water ammonium/nitrogen-15 values suggest that nitrogen isotopic ratios have the potential to be used as tracers in surface waters contaminated with inorganic nitrogen. (Author's abstract)

TOXICITY AND ISOLATION OF THE CYANO-BACTERIUM NODULARIA SPUMIGENA FROM THE SOUTHERN BALTIC SEA IN 1986. Helsinki Univ. (Finland). Dept. of Microbiology. For primary bibliographic entry see Field 5C. W90-0714b

TOXICITY OF CADMIUM TO DIFFERENT LARVAL INSTARS OF THE TRICHOPTERAN LARAVE AGAPETUS FUSCIPES CURTIS AND THE IMPORTANCE OF LIFE CYCLE INFOR-MATION TO THE DESIGN OF TOXICITY

TESTS. University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology. For primary bibliographic entry see Field 5C. W90-07155

RECOVERY OF VIRUSES AND BACTERIA IN WATERS OFF BONDI BEACH: A PILOT

Metropolitan Water, Sewerage and Drainage Board, Sydney (Australia). For primary bibliographic entry see Field 5B. W90-07177

ZIRCONIUM TOXICTTY ASSESSMENT USING BACTERIA, ALGAE AND FISH ASSAYS. Institut National de la Recherche Scientifique, Sainte-Foy (Quebec). For primary bibliographic entry see Field 5C. W90-07221

GAS-CHROMATOGRAPHIC DETERMINA-TION OF TRACE AMOUNTS OF VINYL CHLORIDE IN WATER AND AIR AFTER DER-IVATIZATION TO 1,2-DIBROMOCHLOR-

Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer

Hygiene. J. Wittsiepe, F. Selenka, and E. Jackwerth. Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 336, No. 4, p 322-327, February 1990. 5 fig, 34 ref.

Descriptors: *Dibromochloroethane, *Gas chromatography, *Pollutant identification, *Vinyl chloride, Air pollution, Chemical analysis, Laboratory methods, Water analysis.

A quantitative method for the determination of trace amounts of vinyl chloride in water and air is performed by stripping with 250 ml/min helium from a 1-L sample at 20 C for 30 min to transfer the vinyl chloride into the gas phase. The vinyl chloride is concentrated on an ice-cooled adsorption tube, which is filled with 550 mg of silica gel and 300 mg of activated charcoal. Air samples are taken by drawing a known volume directly through the ice-cooled adsorption tube. The tubes eluted with carbon disulfide and the vinyl chloride is derivatized with bromine water to form 1,2-dibromochloroethane. The derivative is deter-1,2-diptomocnioroetnane. In the derivative is determined by capillary gas chromatography with an electron capture detector. The method was tested using water samples over a range from 0.4 nanograms/L to 1.25 micrograms/L. The detection limits are 0.4 nanograms/L for 1-L. water samples or 50 nanograms/cu m for 7.5 L air. (Author's detection) abstract) W90-07242

SCIENTIFIC BASIS OF BIOASSAY.

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
J. Cairns, and J. R. Pratt.

J. Carras, and J. K. Pratt. Hydrobiologia HYDRB8, Vol. 188/89, p 5-20, De-cember 1989. 2 fig. 4 tab, 49 ref. Army Medical Research and Development Command Contract DAMD17-88-C-8068.

Descriptors: *Bioassay, *Pollutant identification, *Project planning, *Quality control, *Risk assessment, *Toxicity, *Toxicology, *Water pollution effects, Ecotoxicology, Scientific validity, Testing

The ultimate goal of ecotoxicological testing is to predict ecological effects of chemicals and other stressors. Since damage should be avoided rather than corrected after it occurs, the predictive value of such tests is crucial. A modest base of evidence of such tests is crucial. A modest base of evidence shows that, in some cases, extrapolations from bioassays on one species to another species are reasonably accurate and, in other cases, misleading. Extrapolations from laboratory bioassays to re-sponse in natural systems at the population level are effective if the environmental realism of the bioassay is sufficiently high. When laboratory sysoloussay is sufficiently fight, when isoboratory sys-tems are poor simulations of natural systems, gross extrapolation errors may result. The problem of extrapolation among levels of biological organiza-tion has not been given the serious attention it tion has not been given the serious attention it deserves, and currently used methodologies have been chosen for reasons other than scientific validity. As the level of biological organization increases, new properties are added (e.g., nutrient cycling, energy transfer) that are not readily apparent at the lower levels. The measured responses (or end points) will not be the same at all levels of biological organization, making the validation of predictions difficult. Evidence indicates that responses of ecologically complex laboratory systems correspond to predicted and documented patterns in stressed ecosystems. The difficulties of terns in stressed ecosystems. The difficulties of improving the ecological evidence used to predict adverse effects are not insurmountable since the averse effects are not insurmountaine since the essence of predictive capability is the determina-tion of effects thresholds at all levels of organiza-tion. The dilemma between basing predictive schemes on either traditional or holistic methods can only be solved by facing scientific and ethical questions regarding the adequacy of evidence used to make decisions of environmental protection. (Author's abstract) W90-07250

RECENT DEVELOPMENTS IN AND INTER-COMPARISONS OF ACUTE AND CHRONIC BIOASSAYS AND BIOINDICATORS,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. P. Giesy, and R. L. Graney.
Hydrobiologia HYDRB8, Vol. 188/89, p 21-60,
December 1989. 8 fig. 1 tab, 238 ref.

Descriptors: *Bioassay, *Bioindicators, *Risk assessment, *Toxicity, *Water pollution effects, Acute bioassay, Chronic bioassay, Growth, RNA/DNA ratio technique, Reproduction, Sublethal effects, Survival.

The ultimate goal of toxicity testing is to monitor or predict the effects of single compounds, elements or mixtures on the long-term health of individual organisms, populations, communities and ecosystems. All the information required to determine the long-term or 'chronic' effects of toxicants on the survival, growth or reproduction of aquatic organisms is not always available. For this reason,

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the chronic effects of toxicants are often inferred or estimated from observations made during short-term or 'acute' field or laboratory studies, which may be conducted at greater concentrations of toxicant. The observations made in the short-term toxicant. The observations made in the short-term studies are then related to the chronic effects by some statistical relationship. There are basically two approaches: (1) The long-term effects on a parameter, such as survival (lethality) are predictparameter, such as survival (letnanty) are parameter, ed from observations on the same parameter, during short-term exposures; (2) Alternatively, the during short-term exposures; (2) Alternatively, the response of one parameter to long-term exposures of a toxicant can be predicted from the short-term responses of a different parameter. Several different examples of both types of methods for estimating chronic responses from information on more short-term responses are reported, and the rationale, advantages, and disadvantages of each are evaluated. In addition, two biochemical indicators; energetic substrates and RNA/DNA ratio are presented. These indicators both act as sensitive, integrative measures of sublethal effects of contaminants during both acute and chronic exposures. (Author's abstract)

CHOICE AND IMPLEMENTATION OF ENVI-RONMENTAL BIOASSAYS, Sheffield Univ. (England). Dept. of Animal and

Plant Sciences. P. Calow.

Hydrobiologia HYDRB8, Vol. 188/89, p 61-64, December 1989, 12 ref.

Descriptors: *Bioassay, *Bioindicators, *Risk assessment, *Toxicity, *Water pollution effects, Environmental impact, Quality control, Testing pro-

cedures.

Bioassays play a crucial role in assessing the actual or potential impacts of anthropogenic agents on the natural environment. They can be used to probe the extent to which an ecosystem is being or has been polluted, and to predict the ecological impact of agents before release. Problems of implementing bioassays are largely concerned with the effective design of experimental and sampling programs, such that they give decisive and statistically-reliable conclusions about the potential or actual impact of substances. It is concluded that the results of monitoring bioassays that derive from surveys of 'natural' systems, have to be treated with some caution because of the difficulties of ascribing causation and of pseudoreplication. The use of lanted monitors lessens these problems, but questions about the relevance of responses can be legitimately raised. From the point of view of exploring and understanding the ecological relevance of restate the first terms of the control of the ecological relevance of restate the first properties. mately raised. From the point of view of exploring and understanding the ecological relevance of results from bioassays, the experimental method (involving the testing of properly framed models) ought to play a prominent role. There is likely to be considerable overlap here between what is generally regarded as classical ecology and ecotoxicology. Pragmatism also has to play an important part in the choice and implementation of bioassays. Therefore, there must be effective dialogue between those who use bioassays the research comments. tween those who use bioassays, the research community and the regulators. (White-Reimer-PTT) W90-07252

APPLICATION OF BIOASSAYS IN THE RESO-LUTION OF ENVIRONMENTAL PROBLEMS; PAST, PRESENT, AND FUTURE. Sheffield Univ. (England). Dept. of Animal and

Plant Sciences. L. Maltby, and P. Calow. Hydrobiologia HYDRB8, Vol. 188/89, p 65-76, December 1989. 3 fig, 4 tab, 108 ref.

Descriptors: *Bioassay, *Laboratory methods, *Model studies, *Risk assessment, *Toxicity. Water pollution effects, Data acquisition, Environmental impact, Project planning, Quality control, Testing procedure

Literature on bioassays for freshwater systems has been reviewed (between 1979 and 1987) and classi-fied into studies concerned with prediction and assessment and, within these categories, into studies concerned with single-species and multi-species bioassays. Changing trends in the response criteria

and types of organisms used in the predictive tests were judged against results from a similar review carried out in 1979. This led to the conclusion that though there may have been changes in detail, bioassays have remained surprisingly unchanged in general features over this time. Problems of generalization and extrapolation have long been recognized in these approaches. It is suggested that the only dependable way forward is to move away from the inductive approach to one that seeks understanding of how perturbations impact biological systems at various levels and how the impact at one level influences systems at higher levels. The ultimate aim will be to develop complex general models that represent the mechanism of toxicological effects and which, by suitable modifications of parameter values, can identify impacts and make predictions about them. (White-Reimer-PTT)

APPLICATION OF BIOASSAY TECHNIQUES TO WATER POLLUTION PROBLEMS—THE UNITED KINGDOM EXPERIENCE.

Clyde River Purification Board, East Kilbride (Scotland).
D. W. Mackay, P. J. Holmes, and C. J. Redshaw. Hydrobiologia HYDRB8, Vol. 188/89, p 77-86, December 1989. 1 tab, 28 ref.

Descriptors: *Bioassay, *England, *Risk assessment, *Testing procedures, *Toxicity, *Water pollution effects, Ambient toxicity, Laboratory methods, Monitoring, Multi-species tests, Sediments, Sublethal bioassays.

Laboratory tests on single species have been used widely to evaluate the acute effects of potential pollutants. However, the value of such tests, often pollutants. However, the value of such tests, often conducted on exotic species, is receiving increasing criticism. Measurements of more subtle chronic sub-lethal effects are now showing increasing promise as regulatory tools in environmental assessment and pollution control. The techniques being used, and those currently under development for the water pollution control authorities in the United Mixeden are senioused. All blooks there here United Kingdom are reviewed. Although there has been a general reluctance in the United Kingdom been a general reluctance in the United Kingdom water industry to utilize bioassay techniques fully, a few authorities have found such tests to be a useful addition to their control and monitoring procedures. Four areas of interest appear to be of special promise: (1) increased use of sub-lethal bioassays and ambient toxicity tests; (2) increased use of sediment toxicity tests; (3) the development of ecotoxicological methods for assessing the impact of episodic pollution; and (4) increased use of multi-species toxicity tests. Toxicity tests can never fully replace chemical analyses or biological surveys. But used wisely can increase the cost surveys, but used wisely can increase the cost efficiency of other monitoring tools. (Author's abstract) W90-07254

USE OF ENVIRONMENTAL ASSAYS FOR IMPACT ASSESSMENT.
Pacific Northwest Research Foundation, Seattle,

D. C. Malins.

Hydrobiologia HYDRB8, Vol. 188/89, p 87-91, December 1989. 16 ref.

Descriptors: *Bioassay, *Pollutant identification, *Risk assessment, *Toxicity, *Water pollution effects, Chronic effects, Physiological ecology, Sedi-

The assessment of impacts of chemically contami nated aquatic environments on animal systems has a number of shortcomings. These include problems with analyses for toxic chemicals and the relevance of bioassays for predicting risk to ecosystems. It is not possible to analyze for all the chemicals that are contained in sediments from polluted environnot possible to analyze for all the chemicals that are contained in sediments from polluted environments, compounds that are below normal detection thresholds can still be a problem for exposed organisms because they are extensively bioconcentrated. Chemical analytical data tells very little, in specific terms, about toxicity--the particularly crucial issue in the assessment of risk. The ability to predict the occurrence of significant biological

change is a vital ingredient in the diagnosis of potential environmental impacts. One of the best hopes for solving this problem is the development of predictive tests focusing on alterations at the sub-cellular level. An increased effort directed toward understanding the underlying mechanisms and processes that govern the effects of pollution on marine ecosystems is needed. A sounder basis is needed for measuring and understanding toxicity and its implications for the health of organisms and the survival of ecosystems. (White-Reimer-PTT) W90-07255 W90-07255

PROBING ECOSYSTEM HEALTH: A MULTI-DISCIPLINARY AND MULTI-TROPHIC DISCIPLINARY AND ASSAY STRATEGY.

Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and

nawar, I. F. Munawar, C. I. Mayfield, and

M. Mutawai, 17 Managara L. H. McCarthy. Hydrobiologia HYDRB8, Vol. 188/89, p 93-116, December 1989. 12 fig, 1 tab.

Descriptors: *Bioassay, *Risk assessment, *Testing procedures, *Toxicity, *Water pollution effects, Ecosystem management, Field tests, Field-to-laboratory approach, Great Lakes, Laboratory methods, Primary productivity, Trophic level. ary productivity, Trophic level.

The ecosystem health of stressed environments in the Great Lakes has been evaluated simultaneously by means of a battery of structural and functional tests based on current technology and involving various trophic levels. These tests attempt to assess ecosystem health at the organism level and simultaneously focus on water-borne and sediment-bound toxicities. Similarly, functional tests were selectively chosen across various trophic levels and included size-fractionated primary productivity (filtered ly chosen across various trophic levels and included size-fractionated primary productivity (filtered versus unfiltered assays), and Colpidium, Daphnia, Hyalella, and Pontoporeia assays. Some of the emerging techniques such as in situ plankton cages (I.P.C.), microcomputer-based chlorophyll fluorescence (Video Analysis System), and other assays are evaluated. The multi-trophic and multi-disciplinary battery of tests followed in this laboratory adopts a field-to -laboratory approach. The availability of diverse bioassays have placed toxicologists and environmentalists in a position where they are now better equipped to probe the complexities of ecosystem health and its management. (Author's abstract) (Author's abstract)

FUNCTIONAL BIOASSAYS UTILIZING ZOO-PLANKTON: A COMPARISON.

Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.

and Denaylon.

D. C. McNaught.

Hydrobiologia HYDRB8, Vol. 188/89, p 117-121,
December 1989. 6 tab, 17 ref. E.P.A. CR 810775.

Descriptors: *Bioassay, *Pollutant identification, *Testing procedures, *Toxicity, *Water pollution effects, *Zooplankton, Comparison studies, Heavy metals, Hormesis, Ingestion, Nutrients, Pesticides, Polychlorinated biphenyls, Reproduction, Respiration, Temperature, Temperatur

Functional zooplankton bioassays based on ingestion, reproduction, and respiration were conducted. A new ingestion bioassay included. The ingestion bioassay had a medium level of variability, but illustrated the greatest range of response. It detected effects of toxic organics, heavy metals and pesticides. Observation of a hormesis response was common, and it was very sensitive to temperature. The reproduction bioassay was less variable, was less sensitive, and detected heavy metals and nutrients. The zooplankton respiration bioassay was characterized by low variability and detected stimulation by PCB's in one case. (Author's abstract) W90-07257.

HOLISTIC APPROACH TO ECOSYSTEM HEALTH ASSESSMENT USING FISH POPU-LATION CHARACTERISTICS.

Guelph Univ. (Ontario). Dept. of Zoology.

Group 5A-Identification Of Pollutants

K. R. Munkittrick, and D. G. Dixon.

N. R. Mullisturick, and D. O. Dixin. Hydrobiologia HYDRB8, Vol. 188/89, p 123-135, December 1989. 6 tab, 58 ref. Natural Sciences and Engineering Research Council of Canada A8155; Ontario Ministry of the Environment Grants 193 RR and 331 RR

Descriptors: *Bioassay, *Bioindicators, *Environ-mental effects, *Environmental quality, *Fish pop-ulations, *Water pollution effects, Acidification, Condition factor, Eutrophication, Growth, Mine Predation. Reproduction. Reservoirs.

The status of a fish population is a refection of the overall condition of the aquatic environment in which that population resides. As such, fish population characteristics can be used as indicators of environmental health. Simple and inexpensive methods to follow fish population responses to methods to follow fish population responses to environmental degradation are lacking. A protocol is outlined whereby environmental impacts on fish populations are classified by five patterns based on characteristics such as mean age, fecundity and condition factor. The patterns summarize popula-tion changes and describe responses to exploita-tion, recruitment failure, the presence of multiple stressors, food limitation and niche shifts. Classifi-cation is best based on the selection, and appropri-ate sampling, of a comparable reference populaate sampling, of a comparable reference popula-tion. Population characteristics can be used to extion. Population characteristics can be used to examine ecosystems exposed to stressors for evidence of long-term damage, and when used with biochemical indicators, can be a powerful tool for ecosystem health assessment. The five responses are illustrated using published data on a number of species challenged by increased predation pressure, acidification, eutrophication, mine waste and reservoir impoundment. Application of this scheme will aid in directing and focusing research efforts on crucial aspects impacted by changing conditions. (Author's abstract) W90-07258

ROLE OF MICROBIAL METAL RESISTANCE AND DETOXIFICATION MECHANISMS IN ENVIRONMENTAL BIOASSAY RESEARCH. Guelph Univ. (Ontario). Dept. of Environmental

Biology. J. T. Trevors.

Hydrobiologia HYDRB8, Vol. 188/89, p 143-147, December 1989. 1 fig, 30 ref.

Descriptors: *Bacterial physiology, *Bioassay, *Detoxification, *Microorganisms, *Pollutant identification, *Toxicity, *Water pollution effects, Aquatic environment, Metals, Sediments, Sublethal

In the aquatic/sediment environment, bacteria are responsible for a wide range of metal detoxification/resistance mechanisms. In addition, they also act as surfaces or biofilms that can readily complex metal ions. Since most environmental bioassay re-search deals with aquatic and sediment samples, it is necessary to understand the mechanisms that microorganisms have evolved to protect selected strains from a lethal effect. It is noteworthy, that at extremely high levels of free metal ions, resistance/ detoxification mechanisms provide no protection and a lethal toxic effect can be produced. However, in many environmental samples sublethal effects are present, or only a percentage of the total microbial population is influenced. Under these conditions, resistance/detoxification mechanisms are probably very useful. It is also very probable that during many bioassays with higher organisms, numerous microbial processes are occurring simultaneously to bind or detoxify metal ions. This may in fact have an effect on the final outcome of the environmental bioassay. (Author's abstract)

PERFORMANCES OF THREE BACTERIAL ASSAYS IN TOXICITY ASSESSMENT.

Centre des Sciences de l'Environment, Metz (France).

C. Reteuna, P. Vasseur, and R. Cabridenc. Hydrobiologia HYDRB8, Vol. 188/89, p 149-153, December 1989. 1 fig, 15 ref.

Descriptors: *Bacterial physiology, *Bioassay, *Pollutant identification, *Toxicity, *Water pollution effects, Activated sludge, Bioavailability, Biogical wastewater treatment, Comparison studies, Glucose mineralization assay, Microtox assay, Oxygen consumption assay.

Three differing bacterial toxicity assays were com-pared: the 'Microtox' test, (Photobacterium phosphoreum luminescence inhibition assay), the oxygen consumption of activated sludge assay (ISO 8192), and the 'Clucose U-14C mineralization assay (the rate of release of 14CO2 by 'Escherichia assay (the fate of feets of 14-02 by Escherchia coli'). Metals, amines, halogenated alcans, chloro-phenols, aromatic hydrocarbons, surfactants, and pnenois, aromatic nydrocarous, surracans, and pesticides were screened for their toxic activity. Results showed satisfactory repeatability of the three bacterial assays with variation coefficients between 5 and 32%. The 'Microtos' assay was the nost sensitive test evaluated under these condi-tions. The lower sensitivity of the 'oxygen con-sumption' assay may have been due to high con-centrations of substrates which modify toxicant bioavailability, and also to a high biomass/toxic substances ratio. The 'Glucose U-14C mineralization' assay was selective, and low in sensitivity; but the specific species used in this test (Escherichia coli) may have been responsible for this selectivity. The 'Microtox' test appears to be well adapted to The Microtox test appears to be well adapted to the detection of aquatic environmental pollution, and to the toxicity screening of complex solid waste effluents and/or leachates. The 'oxygen consumption' assay can be advantageously used to measure the impact of sewage on activated sludge in biological treatment plants. The 'Glucose U-14C miseralization' assay, which does not require high. mineralization' assay, which does not require high biomass, can be useful for in situ studies using field microorganisms. (Author's abstract) W90-07261

IS THE 'MICROBIAL LOOP' AN EARLY WARNING INDICATOR OF ANTHROPOGEN-

Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.

M. Munawar, and T. Weisse.

Hydrobiologia HYDRB8, Vol. 188/89, p 163-174, December 1989. 6 fig, 3 tab, 31 ref. Volkswagen Foundation Grant 1/63 699.

Descriptors: *Aquatic bacteria, *Bioindicators, *Eutrophication, *Great Lakes, *Plankton, *Water pollution effects, Community structure, Contaminants, Lake Erie, Lake Huron, Lake Michigan, Lake Ontario, Microbial loop, Nutrients, Pico-alvaktor, Literaplacktor, Literapla plankton, Ultraplankton.

Various components of the 'microbial loop' such as bacteria, heterotrophic nanoflagellates and autotro-phic picoplankton were analyzed, for the first time across the Great Lakes, during a cruise in the summer of 1988. In addition, the size fractionated primary productivity using carbon-14 techniques was also determined. The statistical analysis indicated that bacteria, autotrophic picoplankton and ultraplankton/picoplankton productivity were sig-nificantly higher in Lakes Ontario and Erie than Lakes Huron and Michigan. The autotrophic pico-Lakes Huron and Michigan. The autotrophic pico-plankton and ultraplankton/picoplankton produc-tivity was higher in Lake Erie compared to Lake Ontario. The autotrophic picoplankton showed sensitivity to nutrients and contaminants in various types of environments. A dramatic decrease of autotrophic picoplankton in eutrophic-contaminat-ded areas, such as Ashbridges Bay, Hamilton Har-bour and western Lake Erie was observed. Con-versely, in Saginaw Bay, another eutrophic envi-ronment, the autotrophic picoplankton were sig-nificantly higher than in Lake Huron. The sensitiv-ity of autotrophic picoplankton to nutrients/conity of autotrophic picoplankton to nutrients/con-taminants might have implications to trophic interactions. The results suggest that structural and functional characteristics of the 'microbial loop' may be operating differently in stressed versus unstressed ecosystems. The possibility of using au-totrophic picoplankton as an early warning indicaof environmental perturbation is proposed. (Author's abstract) W90-07263

ACCURACY AND INTERPRETATION OF GROWTH CURVES OF PLANKTONIC ALGAE. Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
G. Bolier, and M. Donze.

Hydrobiologia HYDRB8, Vol. 188/89, p 175-179, December 1989. 2 fig, 4 tab, 9 ref.

Descriptors: *Algal growth, *Bioassay, *Data interpretation, *Eutrophication, *Graphical analysis, *Phytoplankton, *Population dynamics, Biomass, techniques. Scenedesmi

Approximately 100 growth curves of Scenedesmus quadricauda in batch cultures on different growth media were analyzed. In many cases after a media were analyzed. In many cases after a retar-dation phase, a second exponential growth phase appears. In may be that cell number remains con-stant during this phase while average cell volume increases. This increase would be recorded by the measurement technique. The definition of 'biomass' in the straingery phase depends on the kind measurement technique. The definition of biomass' in the stationary phase depends on the kind of measurement taken. Especially during the retardation phase and following phases, different properties of the cells begin to vary in different ways; e.g. different properties of a culture are no longer closely coupled by constant conversion factors. Knowledge about the duration of this stationary. phase and about the shape of the decline phase is virtually nonexistent. Observations indicate that these phases vary between different species and depend on the particular limiting factor. In models of plankton dynamics the unspecified 'loss rate' of phytoplankton often is much higher than can be accounted for by grazing and sedimentation. (White-Reimer-PTT)

BIOASSAY USING THE MEASUREMENT OF THE GROWTH INHIBITION OF A CILIATE PROTOZOAN: COLPIDIUM CAMPYLUM

Institut National de la Sante et de la Recherche Medicale, Villeneuve d'Ascq (France). Microbe Ecotoxicology Unit 146. D. Dive, S. Robert, E. Angrand, C. Bel, and H.

Hydrobiologia HYDRB8, Vol. 188/89, p 181-188, December 1989. 2 fig, 3 tab, 20 ref.

Descriptors: *Bioassay, *Protozoa, *Quality control, *Testing procedures, *Toxicity, *Water pollution effects, Laboratory methods, Potassium dichromate. Standardization.

A bioassay method using the ciliate protozoan Colpidium campylum was conducted in a stand-ardized form to determine the influence of the initial cell concentration on potassium dichromate EC50 values. Two intercalibration experiments between two laboratories were performed on ten toxicants in two different conditions. The potassium dichromate ECS0 determinations were per-formed by eight different people. The results showed that some technical aspects such as weigh-ing and dilutions, are more important sources of variation than is generally supposed. The fluctua-tions due to the biological material were estimated tions due to the biological material were estimated and, taking into account the intra-experiment error, a coefficient of variation of 15% in EC50 appears to be optimal. This test can be performed in different laboratories with high coherence in the response integrated over nine products (with a slope close to 1). The comparison of the EC30's based on several products, permits the determination of a response ratio between the laboratories. This method can be applied to the study of pure compounds, mixtures of toxicants and interactions. pounds, mixtures of toxicants and interactions, complexation of metals, industrial waters and leachate products. The limitation of the method is the possible occurrence of insoluble particles in the sample, which can interfere with electronic counting. (White-Reimer-PTT) W90-07265

APPLICATION OF ALGAL GROWTH POTEN-TIAL TESTS (AGP) TO THE CANALS AND LAKES OF WESTERN NETHERLANDS. Hoogheemraadschap van Rijnland, Leiden (Neth-

Identification Of Pollutants-Group 5A

S. P. Klapwijk, G. Bolier, and J. van der Does. Hydrobiologia HYDRB8, Vol. 188/89, p 189-199, December 1989. 3 fig, 6 tab, 34 ref.

Descriptors: *Algal growth, *Bioassay, *Eutrophication, *Netherlands, *Sample preparation, *Scenedesmus, Hydrogen ion concentration, Lake restoration, Limiting nutrients, Nitrates, Nitrogen,

Four hundred and forty bioassays with Scenedesmus quadricauda (Turp.) Breb. as a test organism were carried out with samples from canals and lakes in the western part of the Netherlands. The results were used to assess the algal growth potential (AGP) and to determine the limiting nutrient(s) for maximum biomass production. Special states for maximum biomass production. Special atten-tion was paid to the effects of deep-freezing and autoclaving as pretreatment of water samples on pH and nutrient concentrations. The AGP ranged autociaving as pretreatment of water samples on pH and nutrient concentrations. The AGP ranged from very low in the relatively isolated polder lakes to very high in canals and lakes, which form part of the basin system of Rijnland. The lowest yields were observed in nitrogen and phosphorus co-limited waters, while the highest were found in waters limited by nitrogen alone. AGP proved to be primarily determined by the amount of nitrogen, especially nitrate, in the samples and only secondarily by the amount of phosphorus. The observed ranges indicating phosphorus limitation, >50 for inorganic and >30 for total N/P ratios, lie considerably higher than reported so far. It is concluded that, once the relations between AGP and nutrients are established, AGP tests do not have to be carried out routinely, but still can be very useful in special studies, e.g. in lake restoration projects. (Author's abstract)

STUDY OF PHOSPHATE LIMITATION IN LAKE MAARSSEVEEN: PHOSPHATE UPTAKE KINETICS VERSUS BIOASSAYS. Water Board of Utrecht (Netherlands). E. Van Donk, L. R. Mur, and J. Ringelberg. Hydrobiologia HYDERB, Vol. 188/89, p 201-209, December 1989. 1 fig, 4 tab, 34 ref.

Descriptors: *Bioassay, *Lake Maarsseveen, *Limiting nutrients, *Phosphates, *Phytoplankton, *The Netherlands, *Water pollution effects, Diatoms, Growth, Nutrient uptake, Seasonal variation.

In order to assess possible phosphate limitation for the phytoplankton community of Lake Maarsseveen, two techniques (phosphate uptake experiments and bioassays) were employed simultaneously in February-March 1982. In that period the ambient phosphate concentration of the lake water was less than 0.03 microM P and the diatom Asterionalla formosa constituted more than 90% of the was less than 0.03 microM P and the diatom Asterionella formosa constituted more than 90% of the phytoplankton population. The phosphate uptake experiments showed relatively high uptake capacities and low cell phosphorus contents for the natural phytoplankton community. This suggested phosphate limitation throughout the test period. The growth stimulation of the phytoplankton after enrichment with phosphate, however, only revealed phosphate limitation from the beginning of March and bioassays may therefore be regarded as a less sensitive method. (Author's abstract) W90-07267.

EVIDENCE FROM ALGAL BIOASSAYS OF SEASONAL NUTRIENT LIMITATIONS IN TWO ENGLISH LAKES. Freshwater Biological Association, Ambleside

(England)

(Engiand). F. A. R. Barbosa. Hydrobiologia HYDRB8, Vol. 188/89, p 211-228, December 1989. 9 fig, 28 ref. Brazilian Research Council-CNPq (Proc. 20.1065/85-ZO).

Descriptors: *Algal growth, *Bioassay, *England, *Lakes, *Limiting nutrients, *Limnology, *Phytoplankton, Comparison studies, Iron, Nitrogen, Phosphorus, Potassium, Silicon.

Comparative laboratory bioassays using Asterion-ella formosa and Rhodomonas lacustris as test or-ganisms were performed from March to November 1987 on filtered water samples from two English

lakes, to assess their potential fertility and to identify possible limiting nutrients. The relative growth responses (log2 increments) per week, were measured after additions of P, Fe, Se, N, and K singly ured after additions of P, Fe, Se, N, and K singly and in combinations in comparison with unenriched (control) samples. Phosphate appeared to be the major limiting element for both species throughout the year, except during the spring diatom maxima when silicon usually becomes limiting. On most occasions chelated iron increased the courth increased the seconds in comparison. ing. On most occasions chelated iron increased the growth increments, particularly in combination with phosphate. In general, the bioassay results showed correspondence with the nutrient concentrations in the test waters, which showed low (<1 microg/L) levels of soluble reactive phosphate during all or most of the year and depleted silicon levels in late spring. The results were obtained by the use of relative (incremental) growth measurements based on the ratio of cell numbers at the beginning and end of the incubation period, unlike ments based on the ratio of cell numbers at the beginning and end of the incubation period, unlike the more commonly used absolute (cell concentra-tion) values in which growth is expressed as a concentration yield (usually given in terms of dry or wet weight, optical density, or packed cell volume) after a period of time. (Author's abstract) W90-07268

EARLY WARNING ASSAYS: AN OVERVIEW OF TOXICITY TESTING WITH PHYTO-PLANKTON IN THE NORTH AMERICAN GREAT LAKES.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Augustic Sciences.

(Ontario). Great Lakes Lau. 10. Aquatic Sciences. Aquatic Sciences. M. Munawar, I. F. Munawar, and G. G. Leppard. Hydrobiologia HYDRB8, Vol. 188/89, p 237-246, December 1989. 2 fig, 75 ref.

Descriptors: *Bioassay, *Great Lakes, *Phyto-plankton, *Pollutant identification, *Toxicity, Bioindicators, Microbial loop, Testing procedures.

The use of phytoplankton as test organisms in bioassays has recently gained momentum due to their simplicity, availability, sensitivity, rapidity of their simplicity, availability, sensitivity, rapidity of analysis, and cost-effectiveness. Increasing emphasis is currently being given to field and in situ experiments using indigenous populations, particularly ultraplankton/picoplankton (2-20 microm) which play a key role in the 'microbial loop' and food chain dynamics. Impact evaluation can be determined at the structural, ultra-structural, and functional level. An array of techniques is available for toxicity testing including the use of either algal cultures or natural assemblages in laboratory or in situ experiments, the selection of which depends on situ experiments, the selection of which depends on the objectives, precision required, and project budget of the particular study. An overview is presented of the various procedures using algae in toxicity testing with a focus on the Great Lakes and an emphasis on field techniques. Topics cov-ered include the use of: structural indicators, ultra-structural indicators, and functional indicators. The use of natural assemblages is favored over laboratory-grown cultures because extrapolation of laboratory data to natural conditions is often difficult and misleading. The effective use and application of such sensitive technology has tremendous potential for early warning detection of ecosystem perturbations in concert with a multi-trophic bat-tery of tests. (Author's abstract) W90-07270

CONTINUOUS CULTURE ALGAL BIOASSAYS FOR ORGANIC POLLUTANTS IN AQUATIC ECOSYSTEMS. New York State Dept. of Health, Albany. Wads-worth Center for Labs. and Research. G. Y. Rhee.

Hydrobiologia HYDRB8, Vol. 188/89, p 247-257, December 1989. 5 fig, 26 ref.

Descriptors: *Bioassay, *Culture techniques, *Organic pollutants, *Phytoplankton, *Pollutant identification, Algal physiology, Biomass, Continuous culture, Productivity.

Short-term responses of phytoplankton to organic pollutants are highly transitory. Time-course studies of non-steady state cells in continuous culture showed varying growth or photosynthetic re-

sponses such as enhancement, inhibition, adaptation (or development of resistance) or rebound, depending on the direction of changes in the intra-cellular toxicant concentration and the duration of exposure. However, steady-state cells in a two-stage chemostat system exhibited an increased tolce to toxicants and subtle physiological effects such as photosynthetic enhancement which was accompanied by a considerable leakage of photo-synthesates. It is important to understand such symmetates. It is important to understand such steady-state responses for the prediction and assessment of ecological impact by organic pollution on phytoplankton, since the time scale of changes in the toxicant/biomass ratio in most natural waters is long enough to approximate an equilibrium state. (Author's abstract) W90-07271

ROUND ROBIN TESTING WITH THE SELEN-ASTRUM CAPRICORNUTUM MICROPLATE TOXICITY ASSAY.

Department of the Environment, Sainte-Foy (Quebec).
C. Thellen, C. Blaise, Y. Roy, and C. Hickey.
Hydrobiologia HYDRB8, Vol. 188/89, p 259-268, December 1989. 4 fig, 6 tab, 17 ref.

Descriptors: *Bioassay, *Quality control, *Selenastrum, *Toxicity, Cadmium, Culture techniques, Growth, Microplate bioassay, Phenols.

Three Quebec-based ecotoxicological laboratories Three Quebec-based ecotoxicological laboratories participated in an intercalibration exercise to assess the performance of a recently-published cost-efficiency cient algal microplate toxicity assay. Three test series were carried out with six operators (2 from each laboratory) and two reference toxicants (Cd as CdCl2 and phenol). Variables included algal cultivation technique (series 1), presence or ab-sence of Na2EDTA in the growth medium (series sence of Na2EDTA in the growth medium (series 2), and passive or active gas exchange during incubation (series 3). Control growth variability conferred an overall test precision of 8.7% (coefficient of variation obtained for 204 microplate tests). Cadmium (96 h EC50 = 56 microg/L) and phenol (96 h EC50 = 697 mg/L) toxicity test reproducibility was reflected by coefficients of variation of 24.3% and 34.9%, respectively. Algal cultivation technique, whether standardized or 'in house', had no effect on toxicity results. Na2EDTA, as part of the growth medium, significantly ameliorated algal growth and toxicity. While active gas exchange during microplate incubation significantly improved growth, toxicity results were unaffected. This effect can be offset, however, by providing appropriate modifications to better seal individual wells and to improve experimental design. (Author's abstract) wells and to improve experimental design. (Author's abstract) W90-07272

PHYTOPLANKTON RECOVERY RESPONSES AT THE POPULATION AND COMMUNITY LEVELS IN A HAZARD AND RISK ASSESS-MENT STUDY.

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5C.

W90-07273

COMPARISON OF FIVE BIOASSAY TECHNIQUES FOR ASSESSING SEDIMENT-BOUND CONTAMINANTS.

Technische Univ. Hamburg-Harburg (Germany, F.R.).

W. Ahlf, W. Calmano, J. Erhard, and U. Forstner. Hydrobiologia HYDRB8, Vol. 188/89, p 285-289, December 1989. 4 fig, 1 tab, 16 ref.

Descriptors: *Algal growth, *Bioassay, *Sediment contamination, *Toxicity, *Water pollution effects, Biomass, Comparison studies, Elutriates, Microorganisms, Neubauer phytoassay.

An algal assay was compared with four sediment bioassays using bacteria, algae, and higher plants as indicators. Three different sediments from the Hamburg, Germany area were used for the investi-gation and the following assays were used: (1) elutriate bioassays designed for monitoring dredg-

Group 5A—Identification Of Pollutants

ing projects; (2) an elutriate test that simulates the ing projects; (2) an clutrate test that simulates the immediate impact of resuspended sediments on the water column with a recirculating system to determine to what extent the contaminants are available within a certain period of time and how they affect the test organism; (3) DNA content to describe the reactions of microbial biomass; (4) bioactivity of reactions of microotal tolomass; (4) illocativity of microorganisms; and (5) the Neubauer phytoassay to evaluate seed germination and initial plant growth. The results indicated that Neubauer phytoassay was the most sensitive. The microbial biological properties of the properties o toassay was the most sensitive. In emicrobial toic-mass and algal growth tests indicated a response to the availability of contaminants and nutrients. It is suggested that a diversity of bioassays is useful in toxicity testing of sediment contamination. (White-Reimer-PTT) W90-07275

ASSESSING TOXICITY OF LAKE DIEFEN-BAKER (SASKATCHEWAN, CANADA) SEDI-MENTS USING ALGAL AND NEMATODE BIOASSAYS.

BIOASSAYS. Environmental Protection Service, Regina (Sas-katchewan). Water Quality Branch. D. J. Gregor, and M. Munawar. Hydrobiologia HYDRBs, Vol. 188/89, p 291-300, December 1989. 3 fig. 3 tab, 19 ref.

Descriptors: *Algal growth, *Bioassay, *Lake Diefenbaker, *Pollutant identification, *Saskatchewan, *Sediment contamination, *Toxicity, Algal Fractionation Bioassays, Chemical fractionation, Nematodes, Phytoplankton.

Lake Diefenbaker, on the South Saskatchewan River, Saskatchewan, Canada, receives, on average, 90% of its inflow from snowmelt and rainfall in the Rocky Mountains. The inflowing rivers also receive irrigation return flows and municipal and industrial effluents which may result in the contamination of lake sediments. The sediments were assessed by nematode and algal bioassays. The toxicity of five chemical fractions of the sediment was determined using the nematode. Pengarellus was determined using the nematode Panagrellus was determined using the nematode ranagrenius redivivus as the test organism. The results suggest that the sediment chemical fractions frequently inhibit growth and maturation, while lethality was observed at 4 of 12 sites. Samples from 3 of these sites were further evaluated using conventional sues were furtner evaluated using conventional elutriate Algal Fractionation Bioassays (AFB) with both natural Lake Diefenbaker phytoplankton and a mixed laboratory grown algal culture. The natural phytoplankton showed inhibition at sediment:water ratios of 10:1; whereas the algal sediment:water ratios of 10:1; whereas the algal cultures showed both enhancement and inhibition. Evidently, the sediments are frequently toxic to the species tested except for the algal culture. The AFB assesses the mitigative and synergistic effects of contaminants and nutrients and being a conventional elutriate, is more realistic and potentially more acceptable than the chemical fractionation/nematode bioassay technique which essentially considers potential trace organic contaminant effects. (Author's abstract) W90-07276

FRASER RIVER SEDIMENTS AND WATERS EVALUATED BY THE BATTERY OF SCREEN-ING TESTS TECHNIQUE.

National Water Research Inst., Burlington (Ontar-io). Rivers Research Branch. B. J. Dutka, T. Tuominen, L. Churchland, and K.

K. Kwan. Hydrobiologia HYDRB8, Vol. 188/89, p 301-315, December 1989. 1 fig, 4 tab, 17 ref.

Descriptors: *Bioassay, *Fraser River, *Pollutant identification, *Sediment contamination, *Testing procedures, *Toxicity, Biochemical tests, British Columbia, Comparison studies, Daphnia, Microbiological studies.

The suitability of a variety of microbiological, biochemical and toxicant screening tests to become part of a battery of test procedures to identify degraded or degrading water bodies was evaluated. Data were collected from 40 sampling sites within the Fraser River Basin in British Columbia. These data re-emphasize that individual toxicant, biochemical or microbiological screening tests do not provide a sufficient data base upon which

realistic management decisions can be made. The results also confirm that the fecal sterol tests do not seem amenable to a 'battery of tests' approach, and that the Daphnia magna test continues to be the most sensitive procedure for indicating the presence of contaminants with toxicant activity. presence of contar (Author's abstract)

BIOASSAY RESPONSES OF MICRO-ORGANISMS TO SEDIMENT ELUTRIATES FROM THE ST. LAWRENCE RIVER (LAKE ST. LOUIS).

Environment Canada, Montreal (Quebec) H. Sloterdijk, L. Champoux, V. Jarry, Y. Couillard, and P. Ross.

Countard, and P. Ross. Hydrobiologia HYDRB8, Vol. 188/89, p 317-335, December 1989. 5 fig, 13 tab, 47 ref. Natural Sciences and Engineering Research Council of Canada NSERC-G1571.

Descriptors: *Bioassay, *Canada, *Chlorinated hydrocarbons, *Hazard assessment, *Heavy metals, *Pollutant identification, *Sediment contamination, *St Lawrence River, *Toxicity, Carbon radioisotopes, Cladocera, Microtox assay, Nematodes, Ro-

A sediment study, involving both chemical and biological analyses, was carried out in the St. Law-rence River near Montreal (Lake St. Louis). About 60 stations were sampled during 1984-85, and the sediments were analyzed for support variables, sediments were analyzed for support variables, heavy metals, and organochlorinated compounds. Subsamples were elutriated using a 1 to 4 sediment/vater ratio. The resulting elutriates were analyzed for several chemical variables, while toxicity was measured using the Microtox test, algal 14C assimilation, and lethality/developmental inhibition in cladocerans, rotifers, and nematodes. The results showed a great variety of responses and sensitivity, and correlations between the tests were non-significant. In terms of toxic responses, the sensitivity, and correlations between the tests were non-significant. In terms of toxic responses, the algal and Microtox tests were the most sensitive. Toxic responses could not be explained in simple terms of contaminant concentrations. Therefore, the chemistry of elutriates is not predictive of the toxic potential of contaminated sediments. Biotests can give an insight into the hazard assessment of sediments, but no simple test will be sufficient of can give an insight into the nazaru assessment or sediments, but no single test will be sufficient; the use of a battery of standardized biotests, represen-ting different levels of organization/food chain, in-cluding representative natural species, is highly recommended. (Author's abstract) W90-07278

METAL CONTAMINATION IN SEDIMENTS AND BIOTA OF THE BAY OF QUINTE, LAKE ONTARIO, CANADA.

Queen's Univ., Kingston (Ontario). Dept. of Biology. A. Crowder, W. T. Dushenko, J. Greig, and J. S.

Hydrobiologia HYDRB8, Vol. 188/89, p 337-343, December 1989. 1 fig, 3 tab, 27 ref.

Descriptors: *Bay of Quinte, *Bioaccumulation, *Bioassay, *Canada, *Heavy metals, *Pollutant identification, *Sediment contamination, *Water pollution effects, Atomic absorption spectrophotometry, Chemical analysis, Metals, Mine wastes, Moira River, Neutron activation analysis.

The Bay of Quinte receives drainage from several large river systems, including the Moira River which carried sediment from mines into the Bay from the 1880s to the 1960s. The possible metal trom the 1880s to the 1960s. The possible metal contamination of submerged weed beds and marsh biota which may contribute to the low diversity and biomass of macrophyte beds and Typha marshes in the Bay was investigated. In 1987, sediment, macrophytes, and snails were sampled in wetlands close to the Moira River and at Hay Bay (part of the Bay of Quinte presumably unaffected by mine effluents) located 20 km from the Moira. Some element concentrations in sediment and biota were determined by neutron activation analysis. were determined by neutron activation analysis (NAA) including Al, As, Br, Ca, Co, Cl, Cr, Cs, Fe, Hf, K, La, Na, Mg, Sb, Sc, Rb, Ta, Th, Ti, U, and Zh. Other elements were analyzed by acid dissolution and atomic absorption spectrophoto-

metry (AAS) including Ag, As, Cu, Hg, Ni, Pb, and Zn. Levels of As in sediments and plants were higher close to the Moira River, whereas Cu and Ni showed the opposite pattern in sediments. The usefulness of species as bioassays differed: Stagnicola elodes Say accumulated significantly higher levels of Cu (35 vs 18 ppm) and V (1.1 vs 0.5 ppm) than Planorbella trivolvis Say collected from the same sites. The macrophyte, Myriophyllum spicatum L. acted as an accumulator of Pb (up to 9.6 ppm), whereas Pb in Vallisneria americana Michx. at the same sites was undetectable. (Author's abstract)

USE OF AQUATIC MACROPHYTES AS A BIO-ASSAY METHOD TO ASSESS RELATIVE TOX-ICITY, UPTAKE KINETICS AND ACCUMU-LATED FORMS OF TRACE METALS.

King's Coll., London (England). Div. of Biosphere

S. Smith, and M. K. H. Kwan. Hydrobiologia HYDRB8, Vol. 188/89, p 345-351, December 1989. 3 fig, 1 tab, 3 ref.

Descriptors: *Aquatic plants, *Bioaccumulation, *Bioassay, *Cadmium, *Duckweed, *Thallium, *Toxicity, *Water pollution effects, Hydrogen ion concentration, Organic ligands, Plant physiology,

The macrophyte Lemna minor exposed to thallium and cadmium was used to demonstrate the relationship between exposure, tissue concentration and toxicity. Flowthrough, continuous exposure systems were developed to study metal uptake kinetics as a function of time and concentration and metal efflux. Short-term 24 hr metal exposures and metal efflux. Short-term 24 hr metal exposures were used to examine factors influencing uptake and the accumulated forms of the metals. The results indicated that thallium is near to one order of magnitude more toxic than cadmium but at equimolar exposures Lemna accumulates considerably more cadmium than thallium. It is thought ably more cadmium than thallium. It is thought that these differences may be explained in terms of the physicochemical properties of the two elements and hence in the dynamics of the metals in the plant tissues. Thus, thallium is a 'mobile' element with little affinity for organic ligands and its ion activity is relatively unaffected by changes in pH. Thallium in the cell behaves in an analogous fashion to potassium, even to the point that the cell vacuole is a likely site of accumulation. Cadmium, on the other hand, has a strong affinity for organic ligands and a major proportion of the element in Lemna tissues is complexed with the pectins of the nganos and a major proportion of the element in Lemna tissues is complexed with the pectins of the cell wall and even in the soluble phase much of the Cd is bound to protein fractions. An understanding of the uptake mechanisms, the distribution and accumulated forms of trace metals in plants are accumulated to this of the metas in plants are integral components of bioassay procedures for metal toxicity assessment and biological monitor-ing. (White-Reimer-PTT) W90-07280

BIOASSAYS WITH A FLOATING AQUATIC PLANT (LEMNA MINOR) FOR EFFECTS OF SPRAYED AND DISSOLVED GLYPHOSATE. Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst. For primary bibliographic entry see Field 5C. W90-07281

PHYTOMONITORING OF PULVERIZED FUEL ASH LEACHATES BY THE DUCKWEED LEMNA MINOR.

Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Environmental Dept. For primary bibliographic entry see Field 5B. W90-07282

ROOT AND SHOOT ELONGATION AS AN AS-SESSMENT OF HEAVY METAL TOXICITY AND 'ZN EQUIVALENT VALUE' OF EDIBLE

Hong Kong Baptist Coll., Kowloon. Dept. of Biol-For primary bibliographic entry see Field 5E.

W90-07283

EFFECTS OF ACIDITY ON ACUTE TOXICITY OF ALUMINIUM-WASTE AND ALUMINIUM-CONTAMINATED SOIL. Hong Kong Polytechnic, Kowloon. Dept. of Applied Biology and Chemical Technology. For primary bibliographic entry see Field 5B. W90-07284

DO BIOASSAYS ADEQUATELY PREDICT EC-OLOGICAL EFFECTS OF POLLUTANTS, Oslo Univ. (Norway). Dept. of Marine Zoology

Oslo University.
J. S. Gray.
Hydrobiologia HYDRB8, Vol. 188/89, p 397-402,
December 1989. 3 fig. 1 tab, 11 ref.

Descriptors: *Bioassay, *Hazard assessment, *Mol-lusks, *Water pollution effects, Ecological sensitiv-ity, Growth bands, Oil pollution, Variability.

With some notable exceptions, such as the echino-derm and oyster larvae tests, the species tradition-ally used in bioassays are not sufficiently sensitive to detect subtle ecological effects of pollutants. It is suggested that by using ecological criteria, spe-cies can be identified from any pollution gradient that are sensitive to subtle effects of pollution. Examples are given using gradients of oil, sewage and titanium dioxide pollution, showing how eco-logically sensitive species for use in laboratory bioassays can be selected objectively. Many marine mollusks show microgrowth bands, which can be used as in situ field bioassays. Using the bivalve Cerastoderma edule a sequential series of photo-graphs showing microgrowth bands over many graphs showing microgrowth bands over many months were obtained. The data was subjected to months were obtained. The data was subjected to time series analyses to ascertain the dominant periods shown in the microgrowth pattern. The analyses showed that it was tides and not diurnal paterns that initiated the microgrowth bands. From such an analysis C. edule can be used to monitor retrospectively the spatial and temporal effects of a pollutant event such as an oil spill. The results show that variation between individuals from the same locality is fairly low and that a sample of 5 individuals of the same approximate size gives a measure of the natural variability. (Author's abstract) stract) W90-07285

DAPHNIA BIOASSAY: A CRITIQUE. Sheffield Univ. (England). Dept. of Animal and Plant Sciences

D. J. Baird, I. Barber, M. Bradley, P. Calow, and A. M. V. M. Soares.

A. M. V. M. Soares. Hydrobiologia HYDRB8, Vol. 188/89, p 403-406, December 1989. 4 fig. 1 tab, 8 ref. NERC grant TSF/8a6/Ae/4, EC contracts CCAM/87/319 and B/86000160 and NATO grant 3/A/87/PO.

Descriptors: *Bioassay, *Daphnia, *Hazard assessment, *Model studies, *Quality control, *Testing procedures, *Toxicity, *Water pollution effects, Culture techniques, Guidelines, Interactive effects, Quantitative genetic models.

Daphnia magna is used widely as a standard ecotoxicological indicator organism, and protocols exist for its use in assessing the toxicity of substances under acute and chronic experimental constances under acute and chronic experimental conditions. However, problems exist in the repeatability of such bioassays between laboratories. Sources of variation were identified using a simple quantitative genetics model. It was concluded that the following factors should be considered in conducting these bioassays: (1) To improve consistency in the D. magna bioassay among testing labs, both genotype and culture conditions must be specified. Test protocols must be unambiguous; if tests are carried out under conditions that deviate from the protocol the results must be discarded; (2) Further research into each of the components of from the protocol the results must be discarded; (2) Further research into each of the components of the model should identify which clone(s) is suitable for testing purposes, and should lead to the formulation of 'good laboratory practice' guidelines; and (3) While in principle it should be straightforward to minimize variability due to genetic heterogeneity and environmental heterogeneity, the interac-

tive effects arising from the variability due to genotype by environmental interaction are likely to be subtle and merit more detailed investigation. (Author's abstract) W90-07286

LIFE-TABLES OF DAPHNIA OBTUSA (KURZ) SURVIVING EXPOSURE TO TOXIC CONCEN-TRATIONS OF CHROMIUM.

Istituto Italiano di Idrobiologia, Pallanza (Italy). For primary bibliographic entry see Field 5C. W90-07287

TOXICITY OF THE NEW PYRETHROID IN-SECTICIDE, DELTAMETHRIN, TO DAPHNIA

Institute of Environmental Health and Engineer-

Institute of Lawray.

ing, Beijing (China).

R. Xiu, Y. Xu, and S. Gao.

Hydrobiologia HYDRB8, Vol. 188/89, p 411-413,

December 1989. 2 tab, 8 ref.

Descriptors: *Bioassay, *Daphnia, *Deltamethrin, *Insecticides, *Pollutant identification, *Toxicity, Juveniles, Neonates, Pyrethroid pesticides, Residues, Sediment contamination.

The toxicity of deltamethrin, a synthetic pyrethroid insecticide, was determined under standardroid insecticide, was determined under standard-ized conditions in neonates and juveniles of Daph-nia magna. Neonates (6 to 24 h old) were more sensitive than juveniles (48 to 72 h old). The 24-h and 48-h EC50s (immobilization) in neonates were 0.113 and 0.031 microg/L, respectively. The delta-methrin was highly toxic. The 96-h EC50 was in the ppt (microg/L) range. Toxicity tests with Daphnia may be used to detect toxic residues in water and sediment in areas treated with delta-methrin and other highly toxic pryethroid perspective. methrin and other highly toxic pyrethroid pesti-cides. (Author's abstract) W90-07288

HERBICIDE EFFECTS ON PLANKTONIC SYSTEMS OF DIFFERENT COMPLEXITY.

Max-Planck-Inst. fuer Limnologie zu Ploen (Ger-

W. Lampert, W. Fleckner, E. Pott, U. Schober, and K. U. Storkel. Hydrobiologia HYDRB8, Vol. 188/89, p 415-424, December 1989. 9 fig, 1 tab, 23 ref.

Descriptors: *Atrazine, *Bioassay, *Daphnia, *Herbicides, *Plankton, *Pollutant identification, *Toxicity, Direct effects, Growth, Indirect effects, Recovery, Stress, Sublethal tests.

Bioassays of different complexity were compared with respect to their capability to predict the envi-ronmental impact of the herbicide atrazine in aquatic systems. Acute toxicity tests with Daphnia aquatic systems. Acute toxicity tests with Daphnia did not yield meaningful results. Sublethal tests with Daphnia (feeding inhibition, reduction of growth and reproduction) were more sensitive, but growth and reproduction) were more sensitive, but rather high (2 mg/L). A relatively complicated 'artificial food chain' system that incorporated direct and indirect effects on Daphnia yielded significant reduction of daphnid population growth at 0.1 mg/L. Enclosure experiments with natural communities were by far the most sensitive tools. Community responses could be measured at concentrations as low as 1 microg/L and 0.1 microg atrazine/L. At the lowest concentration, however, arrazine/L. At the lowest concentration, nowever, communities recovered after three weeks. It was concluded that in complex systems indirect effects can be more important than direct effects, so that, contrary to the conditions in simple tests, nontarget organisms may by the better indicators of herbicide stress to natural communities. (Author's

NEW STANDARDIZED SEDIMENT BIOASSAY PROTOCOL USING THE AMPHIPOD HYA-LELLA AZTECA (SAUSSURE).

Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences. U. Borgmann, and M. Munawar.

Hydrobiologia HYDRB8, Vol. 188/89, p 425-431, December 1989. 3 fig, 1 tab, 27 ref.

Descriptors: *Amphipods, *Bioassay, *Great Lakes, *Pollutant identification, *Sediment con-tamination, *Toxicity, Chronic toxicity bioassay, Hamilton Harbor, Hyalella, Lake Ontario, Testing procedures, Toronto Harbor.

A new standardized bioassay procedure for testing A new standardized bioassay procedure for testing the chronic toxicity of sediments to Hyalella azteca was developed. Tests were initiated with 0-1 wk old amphipods exposed to sediments from Hamilton Harbour, Toronto Harbour, and Lake Ontario for 4 to 8 weeks. Both survival and growth were significantly reduced in the Hamilton Harbour significantly reduced in the raminon harboar sediments relative to those from the lake after 4 weeks. Exposures of 8 weeks resulted in greater variability; survival of amphipods in sediments from one of the harbor stations, and growth in sediments from both harbor stations with surviving young were not statistically different from survival and growth in lake sediments. Growth and survivall in lake sediments were comparable to cultures grown with cotton gauze and no sediment after 4 weeks, but survival was poorer by week 8. Repli-cation was good in 12 out of 13 tests done in duplicate; the difference in survival between repli-cates averaged 2.2 animals (20 amphipods/repli-cate, 4 week exposure). It is proposed that 4 week exposures of young (0-1 wk old) Hyalella would provide a suitable standardized chronic toxicity test for sediments. (Author's abstract) W90-07290

VALVE MOVEMENT RESPONSE OF MUSSELS: A TOOL IN BIOLOGICAL MONITOR-ING.

Koninklijk Inst. voor de Marine, Den Helder

Konnkijk Inst. 1907 de Chendralde, New York (Netherlands).
K. J. M. Kramer, H. A. Jenner, and D. de Zwart.
Hydrobiologia HYDRB8, Vol. 188/89, p 433-443,
December 1989. 5 fig, 3 tab, 45 ref.

Descriptors: *Bioindicators, *Mollusks, *Monitoring, *Mussels, *Toxicity, Biological sensors, Early warning systems, Valve movement response.

Biological sensors are becoming more important for monitoring the quality of the aquatic environ-ment. A method using the valve movement re-sponse of freshwater (Dreissena polymorpha) and marine (Mytilus edulis) mussels as a tool in moni-toring studies was developed. Possible applications of the technique include: (1) effluent monitoring; (2) meneral water quality monitoring; (3) monitoring. of the technique include: (1) effluent monitoring; (2) general water quality monitoring; (3) monitoring of water inlets (drinking water, aquaculture); (4) early warning system (alarm function, triggering a water sampler for chemical proof); (5) toxicity testing; and (6) physiological and behavioral studies. The electronic induction system developed for measuring valve movement has several advantages: (1) The electronic interface facilitates automated data collection and data interpretation; (2) Since transmitting and receiving colls attached; (2) mated data collection and data interpretation; (2) Since transmitting and receiving coils attached to the mussel are quite small, and the connecting wires are thin and supple, burrowing bivalves are free to move to some extent; and (3) The small size and rigidity of the system allows its use both under laboratory of the system allows its use both under laboratory and (semi) field conditions, the latter being essential for the application in an Early Warning system. (Author's abstract) W90-07291

PHYSIOLOGICAL BACKGROUND FOR USING FRESHWATER MUSSELS IN MONITORING COPPER AND LEAD POLLUTION. Balatoni Limnologiai Kutato Intezete, Tihany

J. Salanki, and K. V.-Balogh. Hydrobiologia HYDRB8, Vol. 188/89, p 445-454, December 1989. 4 fig, 2 tab, 19 ref.

Descriptors: *Bioaccumulation, *Bioassay, *Copper, *Heavy metals, *Lead, *Mollusks, *Mus-sels, *Water pollution effects, Depuration, Gills, Kidneys, Muscle, Tissues.

In studying the effect of copper (10 +/-0.57 microg Cu/L and 100 +/-3.01 microg Cu/L) and

Group 5A-Identification Of Pollutants

lead (50 +/-1.12 microg Pb/L and 500 +/-12.5 microg Pb/L) on the filtration activity of Anodonta cygnea L., it was found that both heavy metals resulted in significant shortening of the active periods, but little change occurred in the length of the rest periods. The concentrations of length of the rest periods. The concentrations of copper and lead were measured in the gill, foot, mantle, adductor muscle and kidney for 840 hours of exposure to 10.9 +/-5 microg Cu/L and 57.0 +/-19 microg Pb/L as well as during subsequent depuration. Uptake was observed after 72 hours of exposure. The highest copper concentration (59.1 +/-16.2 microg Gu/g) was measured at 672 hr in the mantle, and the highest lead value (143 +/-26.1 microg Pb/g) was obtained in the kidney. Depuration of copper was fastest from the foot, and from the adductor muscle for lead. The gill had the longest half-depuration time (>840 hr for copper and >672 hr for lead). (Author's abstract) W90-07292

APPLICATION OF COMBINED TISSUE RESI-DUE CHEMISTRY AND PHYSIOLOGICAL MEASUREMENTS OF MUSSELS (MYTILUS EDULIS) FOR THE ASSESSMENT OF ENVI-RONMENTAL POLLUTION.

RUNMENTAL POLLUTION. Marine Biological Association of the United King-dom, Plymouth (England). J. Widdows, and P. Donkin. Hydrobiologia HYDRB8, Vol. 188/89, p 455-461, December 1989. 3 fig, 16 ref.

Descriptors: "Bioaccumulation, "Bioassay, "Mollusks, "Monitoring, "Mussels, "Structure-activity relationships, "Toxicity," Water pollution effects, Feeding, Growth, Respiration, Tissues.

The rationale for the use of combined tissue residue chemistry and physiological energetics measurements of Mytilus edulis in the assessment and monitoring of environmental pollution is outlined. Laboratory derived relationships between the con-Laboratory derived relationships between the con-centration of toxicants in tissues and sublethal re-sponses (e.g. feeding, respiration, and growth rate) provide a toxicological database for the interpreta-tion of physiological responses measured in the field. The role of quantitative structure-activity relationships (QSAR) in establishing tissue concen-tration-effect relationships for organic contami-nants was illustrated using two field studies; a monitoring program in the Shetlands, and a practi-cal biological effects workshop in Oslo. Once es-tablished, a QSAR line enables the toxicity of related compounds and mixtures to be predicted. Furthermore, QSARs can be used to compare the sensitivity of different organisms to classes of toxi-cants, so extrapolation from biological effects on muscles to effects on other species becomes feasi-ble. (Author's abstract) centration of toxicants in tissues and sublethal reble. (Author's abstract)

BIOLOGICAL ASSESSMENT OF CONTAMI-NATED SEDIMENT—THE DETROIT RIVER EXAMPLE.

National Water Research Inst., Burlington (Ontar-

io).
T. B. Reynoldson, and M. A. Zarull.
Hydrobiologia HYDRB8, Vol. 188/89, p 463-476,
December 1989. 5 fig. 4 tab, 30 ref.

Descriptors: *Benthos, *Bioassay, *Monitoring, *Pollutant identification, *Sediment contamination, *Toxicity, *Water pollution effects, Data acquisition, Data interpretation, Detroit River, Environ-

Contaminated sediments have been found in almost all water bodies which have at some time received, or are presently receiving, waste inputs from urban and industrial sources. In the Laurentian Great Lakes, sediments are classified as contaminated from bulk chemical analysis. The chemical criteria used to evaluate these results are somewhat arbitrary and only partially consider biological imtrary and only partially consider biological impacts. The absence of adequate linkage among sediment contamination, bioavailability, effects on organisms, populations, and ultimately ecosystem health, represents a major barrier to the restoration and protection of aquatic ecosystems. An integrated strategy for the assessment and delineation of contaminated sediments is proposed which provides a comprehensive evaluation of impact, as well as a cost-effective sampling and testing program. The strategy incorporates the triad approach and is to be executed in two stages. Both stages use physical, chemical and biological information; however, the second stage requires more sampling and analyses to specify the severity and extent of the associated problems. To illustrate the type of output anticipated if the strategy is used, data assembled from the Detroit River are presented. They demonstrate that combined analysis of physical, chemical and biological data can be used to link cause and effect between sediment contaminants and benthic communities. (Author's abstract) W90-07294

METHOD FOR STUDYING THE IMPACT OF POLLUTED MARINE SEDIMENTS ON INTERTIDAL COLONISING ORGANISMS: TESTS WITH DIESEL-BASED DRILLING MUD AND PAINT. TRIBUTYLTIN ANTIFOULING

PAINT.
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
P. Matthiessen, and J. E. Thain.
Hydrobiologia HYDRBs, Vol. 188/89, p 477-485,
December 1989. 4 fig, 2 tab, 20 ref.

Descriptors: *Benthic fauna, *Bioassay, *Organotin compounds, *Sediment contamination, *Toxicity, *Tributyltin, Amphipods, Colonization, Field tests, Fuel, Intertidal areas, Polychaetes.

A novel sediment bioassay which can be used in intertidal mud or sand, thereby exposing a contaminated sediment to a large range of naturally colonizing fauna was developed. Natural sediment, in which invertebrates had been killed by freezing, in which invertebrates had been killed by freezing, was mixed with diesel-based drilling mud (nominally 1000 mg/kg dry wt as diesel-based-mud equivalents) or particulate tributyltin (TBT) copolymer antifouling paint (nominally 0.1, 1.0, and 10 mg TBT/kg dry wt). The contaminated sediments were then re-laid intertidally in trenches lined with polythene mesh. All treatments except 0.1 mg TBT/kg impaired the casting activity of the polychaete, Arenicola marina. Populations of the polychaete, Scoloplos armiger, and the amphipod, Urothoe poseidonis, were reduced in all contaminated treatments, and a dose-resonge effect of nated treatments, and a dose-response effect of TBT was demonstrated. No clear effects on other roups (e.g. molluscs) were seen. The results showed that this is a useful technique, although further development is required before it can be used routinely. (Author's abstract) W90-07295

SCOPE FOR GROWTH IN GAMMARUS PULEX, A FRESHWATER BENTHIC DETRITI-

Sheffield Univ. (England). Dept. of Animal and Plant Sciences.

Plant Sciences.
C. Naylor, L. Maltby, and P. Calow.
Hydrobiologia HYDRB8, Vol. 188/89, p 517-523,
December 1989. 4 fig., 1 tab, 15 ref. Commission of
the European Community Contract STP-0086-1-

Descriptors: *Amphipods, *Animal growth, *Bio-assay, *Energy, *Pollutant identification, *Toxici-ty, *Zinc, Foods, Gammarus, Growth, Metabo-

Although toxic substances affect the physiological Although toxic substances affect the physiological processes of individual organisms, their ecological impacts occur at the population and community levels. However, physiological processes can often be assessed more easily and precisely than population and community ones. It is argued that 'scope for growth' (SFG), the difference between the energy input to an organism from its food and the output from respiratory metabolism, can give a cood physiological measure of stress that at least output from respiratory metabolism, can give a good physiological measure of stress that, at least in principle, is directly related to population and community processes. The scope for growth technique involves monitoring the energy budget of individuals and testing how the various components are affected by stress. When SIG is used to measure the impact of a stress, the observed changes in the energy budget are assumed to be closely related to actual changes in individual

growth rate and fecundity; i.e. they can be readily interpreted in terms of the response of whole individuals and the dynamics of populations to which they belong. Experiments with Gammarus pulex exposed to zinc indicate that the most sensitive component of SfG to stress was the amount of energy absorbed rather than the amount of energy absorbed rather than the amount of energy metababsorbed rather than the amount of energy metabolized. The results further indicated that both zinc and low pH can significantly reduce scope for growth of individuals and that the most sensitive component of the energy budget is food absorp-tion. Therefore, the SfG test can provide a relatively rapid assay, that is at least as sensitive as more long-term chronic tests. (White-Reimer-PTT W90-07298

FEEDING AND NUTRITIONAL CONSIDERATIONS IN AQUATIC TOXICOLOGY. Waterloo Univ. (Ontario). Dept. of Biology. For primary bibliographic entry see Field 5C.

HYPOTHESIS FORMULATION AND TEST-ING IN AQUATIC BIOASSAYS: A DETERMI-NISTIC MODEL APPROACH.

Lakehead Univ., Thunder Bay (Ontario). Dept. of

Lascheau Univ., Innuiter pay (Chianto). Ecq. M. Biology.
L. S. McCarty, G. W. Ozburn, A. D. Smith, A. Bharath, and D. Orr.
Hydrobiologia HYDRB8, Vol. 188/89, p 533-542, December 1989. 5 fig, 41 ref.

Descriptors: *Benzenes, *Bioaccumulation, *Bioas-say, *Data interpretation, *Model studies, *Toxici-ty, Chlorinated aromatic compounds, Kinetics models, Narcotic organics.

The significance of toxicant kinetics information obtained from aquatic toxicity bioassays and bio-concentration tests was examined. The data, bioconcentration kinetics and acute mortality versus concentration kinetics and acute mortainty versus exposure-duration information for juvenile American flagfish (Jordanella floridae) exposed to 1,4-dichlorobenzene, were interpreted in terms of a one-compartment, first-order kinetics model. The one-compartment, tirst-order kinetics model. Ine output of the model was used to formulate a testable hypothesis regarding the comparison of toxicant kinetics derived from both bioconcentration test exposures and toxicity bioassays. The model's estimates of the toxicant body burden attained at mortality were compared with theoretical and observed body burdens from literature sources. The use of a simple, deterministic residue-based, one-compartment, first-order kinetics model to evalucompartment, first-order kinetics model to evaluate existing data, as well as to formulate hypotheses to direct experimental designs, was examined. Advantages of this technique are: (1) explicit hypothesis formulation and testing can be exploited; (2) interpretation of the toxicological significance of the contaminant body burdens present in tissues of fish sampled from natural populations is possible; and (3) possible interpretation of the impacts of pulse toxicant exposure. (White-Reimer-PTT) W90-07300

ANALYSIS OF FISH BILE WITH HPLC--FLU-ORESCENCE TO DETERMINE ENVIRON-MENTAL EXPOSURE TO BENZO(A)PYRENE. Ohio State Univ., Columbus. Dept. of Zoology. E. P. Johnston, and P. C. Baumann. Hydrobiologia HYDRB8, Vol. 188/89, p 561-566, December 1989. 2 fig. 2 tab, 13 ref.

Descriptors: *Benz(a)pyrene, *Bioassay, *Black River, *Fish physiology, *Hydrocarbons, *Liquid chromatography, *Pollutant identification, *Sedi-ment contamination, Bile, Bullhead, Carp, Sedi-

Brown bullhead from the Black River, Ohio, have a high incidence of liver neoplasia which is associated with elevated concentrations of polynuclear aromatic hydrocarbons (PAHs) in the sediment. The use of Bhilary concentrations of benzo(a)pyrene (B(a)P) equivalents as a means for determining PAH exposure was evaluated. Bile was collected from 16 brown bullheads and 8

Identification Of Pollutants-Group 5A

common carp taken from each of two Lake Erie tributaries in Ohio, the industrialized Black River and the non-industrialized Old Woman Creek. Hatchery bullhead (n=8) were used to determine base levels of PAHs. A high performance liquid chromatography (HPLC)-fluorescence technique was used to determine the concentration of B(a)P equivalents in the bile samples. The area of all peaks fluorescing at 380/430 nm was summed to give a single value for B(a)P equivalents in each sample. Concentrations of B(a)P equivalents generally reflected concentrations of PAH in sediment where fish were collected. Bile taken from Black River carp contained the highest concentration of B(a)P equivalents and was significantly different from all other groups. The value obtained for Black River bullhead was also high and was found to be significantly different from hatchery bullhead. B(a)P equivalents varied between carp and bullhead from the same habitat possibly because of differing food habits or metabolic pathways. However, the results indicate that relative levels of B(a)P equivalents in the bile of fish correspond well to B(a)P levels in sediment and may offer a means of determining environmental exposure of fish to the parent compound. (Author's abstract) W90-07302

USE OF SHEEPSHEAD MINNOW (CYPRINO-DON VARIEGATUS) AND A BENTHIC COPE-POD (TISBE BATTAGLIAI) IN SHORT-TERM TESTS FOR ESTIMATING THE CHRONIC TOXICITY OF INDUSTRIAL EFFLUENTS. Imperial Chemical Industries Ltd., Brixham (England), Brixham Lab.

T. H. Hutchinson, and T. D. Williams. Hydrobiologia HYDRB8, Vol. 188/89, p 567-572, December 1989. 4 tab, 12 ref.

Descriptors: *Bioassay, *Copepods, *Fish physiology, *Industrial wastewater, *Minnow, *Toxicity, *Wastewater pollution, *Water pollution effects, Chronic toxicity, Dilution, Monitoring, North Sea.

Summary results of laboratory investigations into potential chronic effects of industrial effluent discharges are presented. The sheepshead minnow (Cyprinodon variegatus) and the benthic copepod (Tisbe battagliai) were selected as test species. Toxicity tests were conducted on newly hatched (approximately 24 hours old) sheepshead minnow larvae. Survival and growth (as dry weight) effects were measured over 7 days. Two different stages of the copepod life cycle were tested: effects on adult female survival and reproduction were measured over 9 days, and naupliar survival over 7 days. The results were incorporated into an existing monitoring program of the effluent disposal area in the North Sea. Predicted effluent dilutions in the disposal area would exceed one million times within 8 hours. This dilution is 18 and 100 times greater than the 7 day lowest no observed effect concentration (NOEC) for copepod and sheepshead minnow respectively. (Author's abstract) W90-07303

IDENTIFICATION OF DEVELOPMENTAL TOXICANTS USING THE FROG EMBRYO TERATOGENESIS ASSAY-XENOPUS (FETAX). Oklahoma State Univ., Stillwater. Dept. of Zoolo-

gy. J. A. Bantle, D. J. Fort, and B. L. James. Hydrobiologia HYDRB8, Vol. 188/89, p 577-585, December 1989. 4 fig, 3 tab, 11 ref.

Descriptors: *Bioassay, *Frogs, *Groundwater pollution, *Teratogenic effects, *Toxicity, *Water pollution effects, Chronic effects, FETAX, Growth, Malformation, Mortality.

Because growth and development are processes sensitive to the action of many chemicals, bioassays that screen for developmental toxicants may be more indicative of chronic effects than acute toxic ty assays. FETAX is a 96 h whole embryo static renewal test employing the embryos of the frog Xenopus laevis. Endpoints are mortality, malformation and growth. Because of the frog's fecundity, its extensive use in basic research and the ability to obtain embryos year-round, it is an ideal organism to use in screening for developmental toxi-

cants. By validating using known mammalian teratogens and the use of rat liver microsomes to stimulate mammalian metabolism, the use of the system was extended for the prescreening of human developmental toxicants. In past validation work, the teratogenicity of 15 to 17 compounds used in validation for a predictive accuracy of approximately 88% were identified. In the present study, the ability of FETAX to detect developmental toxicants in groundwater samples taken from an industrial waste dump was evaluated. FETAX showed that it was sensitive enough to detect developmental toxicants in samples without prior concentration. In some samples, less than half the LCSO concentration was required to cause significant malformation. In some cases, a dosersponse curve was not obtainable but the test results nonetheless indicated some developmental toxicity. These results indicate that it is necessary to routinely screen for developmental toxicants when establishing water quality criteria for the preservation of species and for human health. (Author's abstract)

CELLULAR AND BIOCHEMICAL INDICA-TORS ASSESSING THE QUALITY OF A MARINE ENVIRONMENT.

Quebec Univ., Rimouski.

J. Pellerin-Massicotte, E. Pelletier, and M. Paquet.
Hydrobiologia HYDRB8, Vol. 188/89, p 587-594,
December 1989. 7 fig, 14 ref. Text in French;
English summary.

Descriptors: *Bioaccumulation, *Bioassay, *Bioindicators, *Mercury, *Methylmercury, *Mollusks, *Mussels, *Selenium, *Toxicity, *Water pollution effects, Enzymes, Lysosomal membrane fragility, Malate dehydrogenase activity, Sublethal effects.

Sublethal effects of pollutants were studied in the blue mussel Mytilus edulis L., a good bioaccumulator of contaminants. Mussels were placed in experimental tanks, fed, supplemented with mineral salts and continuous sea water flow and kept 72 hr before the exposure to 0.01 microg/L and 0.3 microg/L methylmercury hydroxide in the presence or absence of selenium, at a concentration of 125 microg/L, a possible antagonist of methylmercury. The contamination protocol was performed during 45 days and a 14 day period of recuperation was allowed. The stress caused by the transplantation of mussels in the laboratory tanks and/or by the presence of pollutants was evaluated by a general indicator of stress developed in the laboratory, the measure of the lysosomal membrane fragility (LMF) of the digestive gland. The effects of contamination on metabolism were measured by the study of the variations of the malate dehydrogenase activity (MDH), a key enzyme of the aerobic metabolism. The first days of the contamination period led to an increased metabolism in the mantle and to a detoxifying mechanism in the hepatopancreas. At days 22 and 29 of the experiment, the affinity of the MDH was greatly decreased with both concentrations of methylmercury and selenium, suggesting a competitive inhibition of the enzymatic activity by the pollutants. LMF increased as the mussels were kept longer in the tanks. Methylmercury increased the stress undergone by the mussels. LMF gives information about the degree of stress of the organism while the biochemical indicator informs about the metabolic effects of sublethal concentrations of pollutants. (Author's abstract)

ROLE AND APPLICATION OF ENVIRON-MENTAL BIOASSAY TECHNIQUES IN SUP-PORT OF THE IMPACT ASSESSMENT AND DECISION-MAKING UNDER THE OCEAN DUMPING CONTROL ACT IN CANADA. Environmental Protection Service, Dartmouth (Nova Scotia). Marine Environmental Branch. For primary bibliographic entry see Field 5E. W90-07307

IN SITU BIOASSESSMENT OF DREDGING AND DISPOSAL ACTIVITIES IN A CONTAMI-NATED ECOSYSTEM: TORONTO HARBOR. Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences. For primary bibliographic entry see Field 5C. W90-07308

IMPROVED ELUTRIATION TECHNIQUE FOR THE BIOASSESSMENT OF SEDIMENT CONTAMINANTS.

Waterloo Univ. (Ontario). Dept. of Biology. S. A. Daniels, M. Munawar, and C. I. Mayfield. Hydrobiologia HYDRB8, Vol. 188/89, p 619-631, December 1989. 2 fig. 7 tab, 19 ref.

Descriptors: *Bioassay, *Bioavailability, *Sediment analysis, *Sediment contamination, *Toxicity, Compressed air, Reciprocal shaker, Rotary tumbling, Wrist-action shaker.

An improved method is proposed for the preparation of sediment elutriates which permits relatively realistic determination of bioavailable contaminants. It suggests the use of rotary tumbling in a cycle of 3-4 rpm to achieve sediment-water mixing. Experiments were undertaken to evaluate the mixing efficiency of the rotary tumbler as compared to that of the compressed air, wrist-action shaker, and reciprocal shaker methods. Sediment to water ratios of 0:1, 1:20, 1:10, and 1:4 were tested over 0.5, 1.0, 24, and 48 hr elution periods. Elutriate evaluations were based on chemical, physico-chemical and gravimetric determinations, and also on 14C-phytoplankton bioassays using Chlorella vulgaris (Beyerinck). Results indicated that rotary tumbling produced the most consistent bioassay-supportable data. It was also the most efficient procedure when used for 1 hr with 1:4 sediment-water mixtures. (Author's abstract)

ACUTE TOXICITY OF INDUSTRIAL AND MUNICIPAL EFFLUENTS IN THE STATE OF MARYLAND, USA: RESULTS FROM ONE YEAR OF TOXICITY TESTING.

Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.

D. J. Fisher, C. M. Hersh, R. L. Paulson, D. T. Burton, and L. W. Hall.

Hydrobiologia HYDRB8, Vol. 188/89, p 641-648, December 1989. 3 fig, 1 tab, 4 ref.

Descriptors: *Bioassay, *Industrial wastewater, *Maryland, *Monitoring, *Municipal wastes, *Pollutant identification, *Regulations, *Toxicity, Acute toxicity, Chesapeake Bay, Estuaries.

In July, 1986 the Johns Hopkins University Applied Physics Laboratory's Ecology Section established a bioassay facility for conducting an effluent biomonitoring program for the State of Maryland. Acute toxicity test procedures were developed and implemented for testing freshwater (Pimephales promelas, Daphnia magna, and Ceriodaphnia sp.) and estuarine (Cyprinodon variegatus and Mysidopsis bahia) invertebrates and fish. Procedures and test species are similar to those used by the U.S. Environmental Protection Agency except that low salinity testing (</= 15 ppt) is conducted with the sheepshead minnow and an estuarine mysid found in the Chesapeake Bay. Results from the first year of the program involving acute screening bioassays of major industrial and municipal dischargers are presented. Over 90 dischargers were tested during the first full year of operation. The frequency of toxicity was 36% and 14% for industrial and municipal dischargers, respectively. Reference toxicity test results are also summarized. Results from these tests are presented by outfall type. A number of examples are presented concerning the use of these data for regulating toxic discharges by the State of Maryland's Department of the Environment. These results indicate the importance of implementing a biomonitoring program with proven, estimated to the program with proven can be readily understood by both regulators and permit holders. (Author's abstract)

Group 5A—Identification Of Pollutants

NITRIFICATION RATES IN THE LOWER RIVER RHINE AS A MONITOR FOR ECO-LOGICAL RECOVERY.

Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). For primary bibliographic entry see Field 5B.

LABORATORY STUDY OF CADMIUM EXPO-SURE IN LITTORINA LITTOREA IN RELA-TION THE ENVIRONMENTAL CADMIUM AND EXPOSURE TIME.

Universidad del Pais Vasco, Bilbao (Spain). Lab. Citologia-Histologia.

J. A. Marigomez, and M. P. Ireland.

Science of the Total Environment STENDL, Vol. 90, p 75-87, January 1990. 5 fig, 1 tab, 48 ref. Spanish Education Ministry Grant F.P.I., A18, Environmental Technology, 1985.

Descriptors: *Bioaccumulation, *Bioindicators, *Cadmium, *Heavy metals, *Mollusks, *Pollutant identification, Performance evaluation, Tissue anal-

The shell weight of winkles (Littorina littorea) can be used as reference parameter for the estimation of organism metal concentration values. Metal bioconcentration in indicator organisms not only varies as a result of size, age, sex, and geographical variation, but as a direct consequence of metal-pollutant damage, the response being a function of metal content. Thus, metal concentration in soft tissues might be overestimated to a different degree depending on the health of the indicator popula-tions. Shell metal content is a good indicator of average environmental conditions for cadmium. average environmental conditions for calculations and the particular properties of the winkle shell. An expression to calculate the exposure time to an average external concentration of cadmium was developed based on laboratory data. Further field research and more complex experimental design are recommended to evaluate the usefulness and sig-nificance of soft body metal index and metal con-centrations in shells as a comparative index of metal pollution. (Author's abstract) W90-07341

SAMPLING BIAS CAUSED BY MATERIALS USED TO MONITOR HALOCARBONS IN GROUNDWATER.

Waterloo Univ. (Ontario). Dept. of Earth Sciences. G. W. Reynolds, J. T. Hoff, and R. W. Gillham. Environmental Science and Technology ESTHAG, Vol. 24, No. 1, p 135-142, January 1990. 4 fig, 3 tab, 41 ref.

Descriptors: *Error analysis, *Groundwater pollu-tion, *Halogenated hydrocarbons, *Pollutant iden-tification, *Sample preservation, *Sampling, *Water analysis, Absorption, Leaching, Model studies, Monitoring, Polymers, Sorption

Laboratory experiments were conducted to evaluate materials used in the construction of groundare materials used in the construction of ground-water monitors for their potential to cause sam-pling bias. Ten materials were exposed to low concentrations of five halogenated hydrocarbons in water for periods up to 5 weeks. Borosilicate glass was the only material that did not diminish the halocarbon concentrations. Three metals, inthe halocarbon concentrations. Three metals, in-cluding stainless steel, apparently transformed the compounds. Six synthetic polymers, including poly(tetrafluoroethylene) and rigid poly(vinyl chloride), absorbed the compounds. The sorption rates were dependent on flexibility of the polymer, water solubility of the compound solution volume to polymer surface area ratio, and temperature. A diffusion model explained the concentration histo-ries of solutions exposed to polymers, and the ries of solutions exposed to polymers, and the diffusion mechanism was confirmed by direct measurement of halocarbon distributions in several of the polymers. The experimentally determined diffusivities and polymer-water partition coeffi-cients for polyethylene were consistent with litera-ture data. (Author's abstract)

STRUCTURAL STUDIES OF MARINE AND RIVERINE HUMIC MATTER BY CHEMICAL DEGRADATION.

BESEADATION. Hamburg Univ. (Germany, F.R.). Geologisch-Pa-laeontologisches Inst. und Museum. For primary bibliographic entry see Field 7B. W90-07369

PY-GC-MS ANALYSIS OF ORGANIC MATTER IN SUSPENDED MATERIAL AND DEPOSITS OF THE SUB-MARINE DELTA OF THE RHONE RIVER (FRANCE). Instituto Ouimico de Sarria, Barcelona (Spain).

Dept. Quimica Analitica.
For primary bibliographic entry see Field 7B.
W90-07370

MAJOR AND TRACE ELEMENTS IN STANDARD AND REFERENCE SAMPLES OF AQUATIC HUMIC SUBSTANCES DETERMINED BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS (INAA). National Inst. of Public Health, Oslo (Norway). For primary bibliographic entry see Field 7B. W90-07371

SPECTROSCOPIC AND COMPOSITIONAL COMPARATIVE CHARACTERIZATION OF LH.S.S. REFERENCE AND STANDARD FULVIC AND HUMIC ACIDS OF VARIOUS

Bari Univ. (Italy). Ist. di Chimica Agraria. For primary bibliographic entry see Field 7B. W90-07372

TRACE ANALYSIS OF VOLATILE CHLORIN-ATION BYPRODUCTS OF AQUATIC HUMIC SUBSTANCES: THMS IN TREATED WATER. National Centre for Scientific Research, Havana

(Cuba). Chemistry Div. For primary bibliographic entry see Field 5F. W90-07377

ANALYSIS OF HUMIC AND LIGNIN COM-POUNDS IN THE NORTHERN BALTIC SEA. National Board of Waters, Helsinki (Finland). For primary bibliographic entry see Field 7B. W90-07383

FREEZE-CORING TECHNIQUE APPLIED TO POLLUTION BY FINE SEDIMENTS IN GRAVEL-BED RIVERS. Loughborough Univ. of Technology (England).

Dept. of Geography. G. E. Petts, M. C. Thoms, K. Brittan, and B.

Science of the Total Environment STENDL, Vol. 84, p 259-272, August 1989. 6 fig, 2 tab, 33 ref.

Descriptors: *Bottom sampling, *Core drilling, *Cores, *Gravel, *Pollutant identification, *Sampling, *Sediment contamination, England, Freezing, Heavy metals, Path of pollutants, River beds, River sediments, Scotland, Sedimentation, Silt.

The substrate of gravel-bed rivers provides a po-tential sink for fine sediments which may be associtential sink for line sediments which may be associated with potentially toxic metals. However, prob-lems of sampling submerged substrates has con-strained investigations of channel substrate pollu-tion. A freeze-sampling technique for gravel-bed rivers allows quantitative determinations of fine sediments. The technique consists of a copper standpipe with an inner steel tube used to inject the standpipe with an inner steet into used to inject the cryogenic medium (liquid carbon dioxide) through fine nozzles into the standpipe. Vaporization of the CO2 causes rapid cooling, freezing intragravel water and gravel particles to form a columnar water and gravel particles to form a columnar frozen core of substrate around the outside of the standpipe. The technique was applied to two case studies dealing with pollution surveys. A case of negative pollution is exemplified by the regulated River Daer in the upper Clyde catchment (Scotland) and the effect of positive pollution is examined for the River Tame which drains the Birmingham conurbation (England). In the River Daer flood control led to the sedimentation and compac-

tion of gravel substrates. In the River Tame, high metal concentrations existed within gravel sub-strates of urban rivers. The case studies demon-strated that the method can be used to establish fine sediment and contaminant profiles for the upper 30 cm of gravel substrates, the critical zone for biota. (Geiger-PTT)

COLUMN LEACHING OF UNRETORTED AND RETORTED OIL SHALES AND CLAYSTONES FROM THE RUNDLE DEPOSIT: WATER LEACHING.

Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Coal Technology. For primary bibliographic entry see Field 5B.

W90-07414

GROUND-WATER MONITORING COMPLI-ANCE PROJECTS FOR HANFORD SITE FA-CILITIES: PROGRESS REPORT FOR THE PERIOD JANUARY 1 TO MARCH 31, 1988. VOLUME 3: APPENDIX A (CONTD).

Battelle Pacific Northwest Labs., Richland, WA. Available from the National Technical Information Available from the National 1 echnical information Service, Springfield, VA. 22161, as DE88-017132. Price codes: A22 in paper copy, A01 in microfiche. Report No. PNL-6581-Vol. 3, May 1988. 587p. DOE Contract DE-AC06-76RLO-1830.

Descriptors: *Data collections, *Groundwater movement, *Groundwater quality, *Hanford Site, *Monitoring, *Washington, *Wells, Inspection, Logging(Recording), Well construction, Well logs.

This appendix is one of nine volumes, and presents data describing wells completed at the Hanford Site during the fourth quarter of calendar year 1987 (October through December). The data in this volume of Appendix A cover the following wells: 299-E32-2, 299-E32-3, 299-E32-4, 299-E32-8, and 299-E33-29. The data are presented in the following order: well completion report/title II inspection list, inspection plan, as-built diagram, logging charts, and drill logs. (See also W90-0747) (Lantz-PTT) W90-07476 W90-07476

GROUND-WATER MONITORING COMPLIANCE PROJECTS FOR HANFORD SITE FACILITIES: PROGRESS REPORT FOR THE PERIOD JANUARY 1 TO MARCH 31, 1988. VOLUME 2: APPENDIX A.

Battelle Pacific Northwest Labs., Richland, WA. Dattelle Pacific Northwest Loss, Richand, WA. Available from the National Technical Information Service, Springfield, VA. 22161, as DE88-017373. Price codes: A99 in paper copy, A01 in microfiche. Report No. PNL—6581-Vol. 2, May 1988. 622p. DOE Contract DE-AC06-76RL0-1830.

*Data collections. *Groundwater Descriptors: "Oronawater movement, "Groundwater quality, "Hanford Site,
"Monitoring, "Washington, "Wells, Inspection, Logging(Recording), Well construction, Well logs.

This appendix is one of nine volumes, and presents data describing wells completed at the Hanford Site during the fourth quarter of calendar year 1987 (October through December). The data in his volume of Appendix A cover the following wells: 299-E27-8, 299-E27-9, 299-E27-10, 299-E28weis: 277-L21-8, 279-E21-9, 299-E27-10, 299-E28-27. The data are presented in the following order: well completion report/title II inspection list, inspection plan, as-built diagram, logging charts, and drill logs. (See also W90-07476) (Lantz-PTT) W90-07477

EXTRACTION OF WATER FROM POROUS MEDIA, ESPECIALLY GYPSEOUS MEDIA, FOR ISOTOPIC ANALYSIS.

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water

For primary bibliographic entry see Field 7B.

Sources Of Pollution—Group 5B

USE OF ELECTROMAGNETIC METHODS IN GROUND-WATER CONTAMINATION STUD-IES: AN APPLICATION AT THE SANITARY LANDFILL, FARMINGTON, CONNECTICUT. Geological sources Div. Survey, Hartford, CT. Water Re-For primary bibliographic entry see Field 7B. W90-07488

BIOLOGICAL TESTING OF SEDIMENT FOR THE OLYMPIA HARBOR NAVIGATION IM-PROVEMENT PROJECT, 1988: GEODUCK, AMPHIPOD, AND ECHINODERM BIOAS-SAYS.

Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.

For primary bibliographic entry see Field 5C. W90-07500

SHORT-TERM METHODS FOR ESTIMATING THE CHRONIC TOXICITY OF EFFLUENTS AND RECEIVING WATERS TO MARINE AND ESTUARINE ORGANISMS.

Environmental Protection Agency, Cincinnati, OH. Office of Research and Development. For primary bibliographic entry see Field 5C. W90-07505

5B. Sources Of Pollution

EROSION, PHOSPHORUS AND PHYTO-PLANKTON RESPONSE IN RIVERS OF SOUTH-EASTERN NORWAY.

Norges Landbrukshoegskole, Aas. Dept. of Soil For primary bibliographic entry see Field 2H. W90-06582

ASPECTS OF THE PHOSPHORUS CYCLE IN HARTBEESPOORT DAM (SOUTH AFRICA), PHOSPHORUS KINETICS. National Inst. for Water Research, Pretoria (South

nary bibliographic entry see Field 2H.

TOXICITY TEST WITH FISHES (TESTE DE TOXICIDADE COM PEIXES MANTIDOS EM

IUXICIDADE CUM PEIXES MANTIDOS EM GAIOLA FLUTUANTE). Universidade Federal de Alagoas, Maceio (Brazil). R. L. Teixeira, and E. S. Ferreira. Revista Brasileira de Biologia RBBIAL, Vol. 49, No. 1, p 193-201, February 1989. 6 fig, 4 tab, 17 ref. English summary.

Descriptors: *Chronic toxicity, *Fish, *Oil industry, *Path of pollutants, *Ponds, *Water pollution effects, Aequidens, Carp, Fish diseases, Hyphessobrycon, Phalloceros, Pirrhulina, Rineloricaria.

This study observed the chronic effects in several species of fishes and evaluated the quality of water in a stabilization pond of the petrochemical industries. Juveniles of eight species were collected in a clean river and maintained in a floating cage immersed in the stabilization pond for about 101 days. The species were: Hyphessobrycon meridionalis, H. reticulatus, H. bifasciatus, Aequidens pertalegrensis, Cyprinus carpio, Phalloceros caudimaculatus, Rineloricaria cadeae, and Pirrhulina australis. Only the species which its feeding habits is mainly Only the species which its feeding habits is mainly on sediment showed deformed bones, such as C carpio and R. cadeae. It is concluded that the chemical products stay detained in the bottom of the pond, while the water can be considered of good quality. (Author's abstract)
W90-06602

RESERVOIRS AND VEHICLES OF SALMO-NELLA INFECTION ON GUAM. Guam Dept. of Public Health and Social Services,

Agana.

R. L. Haddock, F. A. Nocon, E. A. Santos, and T. G. Taylor. ment International ENVIDV. Vol. 16, No. 1, p 11-16, 1990. 2 tab, 14 ref.

Descriptors: *Epidemiology, *Epizootiology, *Guam, *Human diseases, *Salmonella, *Soil contamination, Dogs, Effect of pollutants, Lizards, Vacuum cleaners, Water pollution effects.

A review of salmonellosis surveillance activities was conducted to evaluate the possible role that various reservoirs and vehicles of Salmonella might play in the contamination of Guam's environment and the spread of salmonellosis on the island. A review of laboratory records covering a 17-year period suggested that stray dogs and wild lizards are the animals most likely to be responsible for the high prevalence of Salmonella contamination of soil previously reported on Guam. The observation that home vacuum cleaners also frequently contained Salmonella bacteria has led to development of the hypothesis that the high incidence of infant salmonellosis on Guam may be the result of this contaminated soil being tracked into homes on footwear. Ocean waters are not likely to account for many cases of infant salmonellosis, but their testing may be a useful tool for monitoring Salmonellia in the committee. account for many cases of infant sammonenosis, of their testing may be a useful tool for monitoring Salmonella in the community, and may help in the development of effective measures to reduce the incidence of infant salmonellosis on Guam. (Brunone-PTT

TRACE METALS IN BIVALVES AND SEDI-MENTS FROM TOLO HARBOUR, HONG

Chinese Univ. of Hong Kong, Shatin. Dept. of

Chinese Univ. of Frong Kong, Shauh. Dept. of Biology. K. H. Chu, W. M. Cheung, and S. K. Lau. Environment International ENVIDV, Vol. 16, No. 1, p 31-36, 1990. 2 fig. 1 tab, 19 ref.

Descriptors: *Mollusks, *Path of pollutants, *Sediment contamination, *Tolo Harbor, *Trace metals, Bioaccumulation, Cadmium, Heavy metals, Hong Kong, Iron, Lead, Mussels, Oysters, Seasonal varieties, Standards, Zinc.

Concentrations of iron, copper, zinc, cadmium, and lead were determined in samples of sediment, mussel (Perna viridis), and rock oyster (Saccostrea cucullata) from nine locations in Tolo Harbor, cucullata) from nine locations in Tolo Harbor, Hong Kong. The concentrations of metals in bivalves did not vary greatly from one location to another and showed no correlation with the concentration in sediments. The metal concentrations in bivalves are similar to published results in the same area, and concentrations of cadmium and lead are within the local legislative limits for sea-food. Comparison of metal concentrations in bivalves in March and May 1986 shows that lower concentrations of iron concert and cadmium in valves in March and May 1986 shows that lower concentrations of iron, copper, and cadmium in Perna viridis occurred in May, suggesting seasonal variation of trace metal concentrations in mussels. This reduction was not evident in Saccostrea cucullata. Testing of trace metals, as a pollution monitoring program, is necessary as fish and shell-fish in Tolo Harbor are harvested for human consumption. Recent land reclamation in the harbor area may have reduced the biological availability of the trace metals, keeping the levels of these pollutants within legal limitations for shellfish and fish. (Brunone-PTT)

METHOD FOR PREDICTION OF EXTENT OF MICROBIAL POLLUTION OF SEAWATER AND CARRYING CAPACITY OF BEACHES. Bogazici Univ., Istanbul (Turkey). Dept. of Chemi-cal Engineering.

G. Kocasoy.

Environmental Management EMNGDC, Vol. 13, No. 4, p 469-475, July/August 1989. 4 tab, 25 ref.

Descriptors: *Beaches, *Carrying capacity, *Coastal waters, *Recreation, *Water pollution sources, Biological studies, Data interpretation, Fecal coliforms, Land development, Mathematical equations, Tourism, Wastewater disposal.

An increase in the number of tourists visiting a coast is desired by most countries for economic reasons. However, this increase in tourism may cause pollution of the sea which can only be avoided through proper planning and predicting the

carrying capacity of the coast, in terms of sea pollution. Prediction is especially important in de-veloping countries where wastewater is disveloping countries where wastewater is dis-charged, without any treatment, directly into the sea. In the present study, beaches were classified according to their use, into four groups: coasts that were used only for swimming and recreational purposes; coasts used simultaneously for dwelling, swimming, and recreational uses; coasts along which only dwellings exist; and natural and man-made harbors (i.e., coasts used as shelters). During the survey, 40,320 observations were made be-tween December 1985 and February 1988 to detertween December 1985 and February 1988 to determine the effect of the number of tourists on seawater quality. The results obtained were analyzed with a multilinear regression program to obtain an empirical equation giving the extent of the sea pollution in terms of coliform concentration as a function of population density and other environmental factors. The derived equations enable the determination of the cereming seasoits of a back determination of the carrying capacity of a beach in terms of pollution as well as the expected degree of pollution corresponding to a given population density. It also allows the prediction of the extra carrying capacity that can be obtained by improving the waste disposal conditions. (Author's abstract) W90-06610

NONPOINT SOURCE POLLUTION RISK AS-SESSMENT IN A WATERSHED CONTEXT.

East Carolina Univ., Greenville, NC. Dept. of Geography and Planning. J. D. Phillips.

Environmental Management EMNGDC, Vol. 13, No. 4, p 493-502, July/August 1989. 1 fig, 3 tab, 42

Descriptors: *Data interpretation, *Nonpoint pol-lution sources, *Risk assessment, *Watershed man-agement, Fate of pollutants, Mathematical models, Path of pollutants, Sediment transport, South Platte River, Urban runoff, Water quality.

Nonpoint source pollution (NPS) control requires assessment of the influence of dispersed runoffassessment of the influence of dispersed runoff-contributing areas on downstream water quality. This evaluation must consider two separate phases: site-to-stream loading and downstream fluvial transport. The steps used in this probabilistic NPS risk assessment model are: (1) Obtain an index of the relative contribution at basin mouth attributa-ble to inputs from a given area (i); (2) Convert the index derived to a proportion; (3) determine the flow and concentration coming from upstream; (4) Obtain the probability distribution associated with exceedences of particular standards; and (5) Deter-mine the probability that a given concentration will be exceeded as a result of inputs from i, by multiplying the exceedance probability obtained in step 4 by the spatial probability obtained in step 2. This spatial model has a probabilistic interpretation and can be used in conjunction with a standard dilution model to give a probabilistic estimate of and can be used in conjunction with a standard dilution model to give a probabilistic estimate of the impacts, at the basin mouth, of runoff from a specific upstream contributing area. This is illustrated by applying it to an assessment of the probability that various copper concentrations at the mouth of the urbanized South Platte River basin in Denver, Colorado, will be exceeded as a result of runoff from a subbasin within the city. The spatial framework is useful for evaluating management and control options, since actions within the basin can be directly linked to water quality at a downstream point. (Brunone-PTT)

HEAVY METAL CONCENTRATIONS AVAILABILITY IN THE BOTTOM SEDI-MENTS OF THE PARAIBA DO SUL-GUANDU RIVER SYSTEM, RJ, BRAZIL.

Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica

O. Malm, W. C. Pfeiffer, M. Fiszman, and J. M. P. Azcue.

Environmental Technology Letters ETLEDB, Vol. 10, No. 7, p 675-680, July 1989. 2 fig, 3 tab, 14

Group 5B-Sources Of Pollution

Descriptors: *Brazil, *Heavy metals, *Path of pollutants, *Sediment contamination, Copper, Lead, Paraiba do Sul-Guandu River, Public health, River sediments. Zinc.

The Paraiba do Sul-Guandu River is a highly industrialized and anthropogenically influenced system. Toxic metals originating from large and small metallurgic, steel, chemical and fertilizer industries are mixed with organics released from dye dustries are mixed with organics releases from dye plastics and food industries, as well as with urban wastes. These industrial and domestic wastes dis-charge, with few exceptions, directly into the river water. Metal concentrations were determined in bottom sediments from the River Paraiba do Sul-Guandu to evaluate the degree of pollution impact in comparison with other contaminated water in comparison with other contaminated water bodies, and to provide a better understanding of the biological availability of the metals and any health effects on the regional human population. Three metals (zinc, copper, and lead) were considered the most critical in the area. The calculated distribution coefficients of the three metals indicate that the distribution coefficients of the three metals indicate that lead, followed by copper and zinc, represent a potential risk to the local human population, since the river water is used as a source of drinking water. (Brunone-PTT) W90-06618

HEAVY METAL DETECTION IN THE SEDI-MENT-WATER COMPONENTS OF THE SADO ESTUARY BY MULTIELEMENTAL ANALY-

Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal). For primary bibliographic entry see Field 5A. W90-06620

IN-SITU EXPERIMENTS ON CHANGES OF SOLID HEAVY METAL PHASES IN AEROBIC AND ANAEROBIC GROUNDWATER AQUIFERS.

Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.

U. Forstner, and A. Carstens.
Environmental Technology Letters ETLEDB,
Vol. 10, No. 9, p 823-832, September 1989. 8 fig, 2

Descriptors: *Chemical interactions, *Groundwater pollution, *Heavy metals, *Path of pollutants, *Water chemistry, Aerobic conditions, Anaerobic conditions, Aquifers, Cadmium, Copper, Geochemistry, Lead, Manganese, Quartz.

A dialysis method, based on solid speciation of natural and artificial substrates, has been developed for the in-situ monitoring and long-term prognosis of critical pollutants in groundwater and landfill leachates. Experiments were performed with variable metal dosages on different solid substrates, both natural sediments from groundwater aquifers and surface waters and artificial mixtures of organic (cell walls) and inorganic substrates, which are inserted into anaerobic and aerobic acuifers. Initial ic (cell walls) and inorganic substrates, which are inserted into anaerobic and aerobic aquifers. Initial experiments with low metal dosages in both types of aquifers have indicated that, for example, copper is mobilized from fine-grained sediments under oxic conditions mostly from sulfidic/organic fractions. In anaerobic groundwater lead is mobilized from easily reducible fractions of a mixture of defined solid phases, whereas copper is additionally fixed onto these substrates. Experiments using fresh harbor sludge indicate that manganese which fresh harbor sludge indicate that manganese, which has not been added artifically to the substrate, is typically enriched under anaerobic conditions in the non-residual fractions, and mainly in the ex-changeable, particularly labile forms; no changes were observed in the aerobic groundwater aquifer. Similar results have been found for mixed sub Similar results have been found for mixed sub-strates, consisting of quartz, FeOOH and cell walls. These data suggest that new mineral phases are formed predominantly under slightly anaerobic conditions, which in turn could provide additional adsorption sites for dissolved metals. In this case, it is demonstrated that the behavior of the added race element is independent from variations of substrate composition. Typical examples on the behavior of elements at higher dosages on the subtrate mixture of quartz, FeOOH, and cell walls show that for copper and cadmium, under aerobic

conditions, variations in species distribution of both copper and cadmium are small. These exam-ples demonstrate the significance of the factor 'time' in such studies; in addition, it can be argued that these findings are mainly due to the applicatime in such studies; in adulton, it can be argued that these findings are mainly due to the applica-tion of a stabilized system of hydrological and chemical factors, including biochemical interac-tions. (Brunone-PTT) W90-06624

MONITORING OF WATER QUALITY: SEA-SONAL VARIATIONS OF HEAVY METALS IN SEDIMENT, SUSPENDED PARTICULATE MATTER AND TUBIFICIDS OF THE ELBE

RIVER.
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
M. Kaiser, U. Irmer, and K. Weiler.
Environmental Technology Letters ETLEDB, Vol. 10, No. 9, p 845-854, September 1989. 6 fig, 6

tab. 32 ref.

Descriptors: *Bioindicators, *Elbe River, *Heavy metals, *Monitoring, *Seasonal variation, *Sediment contamination, *Suspended load, *Tubificids, *Water pollution effects, *Water quality trends, Biological studies, Blooms, Cadmium, Lead, Mercury, Phytoplankton.

Seasonal variations of the concentrations of toxic Seasonal variations of the concentrations of toxic heavy metals, such as mercury, cadmium, and lead, in suspended particulate matter (SPM) and sediment in a shallow inlet of the Elbe River, were caused by phytoplankton dynamics. In summer, the phytoplankton bloom caused an increase in SPM content and a higher sedimentation rate. Dilution of the highly polluted SPM coming downstream by authochthonous phytoplankton led to a decrease in heavy metal concentration in SPM and sediment. After the breakdown of the phytoplankton bloom the heavy metal concentration in SPM increased again. No seasonal variations of heavy metal concentration in the tissues of metal concentrations were found in the tissues of tubificids. They are not, therefore, reliable indicators of heavy metal pollution. (Brunone-PTT)

MULTIPHASE AND MULTICOMPOUND MEASUREMENTS OF BATCH EQUILIBRIUM DISTRIBUTION COEFFICIENTS FOR SIX VOLATILE ORGANIC COMPOUNDS, Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.

vironmental Engineering.

D. R. Gan, and R. R. Dupont.

Hazardous Waste and Hazardous Materials

HWHME2, Vol. 6, No. 4, p 363-383, Fall 1989. 4

fig, 12 tab, 36 ref. USGS Grant 14-08-0001-G1279.

Descriptors: *Batch equilibrium system, *Path of pollutants, *Pollutant identification, *Volatile organic compounds, Benzenes, Dichlorobenzene, Soil contamination, Toluene, Trichloroethane.

The purpose of this study was to evaluate the feasibility of using a multiphase batch equilibrium system with a mixture of compounds to determine environmental distribution coefficients. Six volatile organic compounds were used in this study: 1,1, trichlorethane, benzene, toluene, 1,1,2-trichlorethane, p-xylene, and m-dichlorobenzene. The distriane, p-xylene, and m-dichlorobenzene. The distri-bution coefficients among soil system compart-ments (air, water, soil, and non-aqueous phase iquid) using individual compounds and their mix-tures in two-phase and multiphase analyses are presented. No statistically significant differences were observed between mixture and single compound results in two-phase batch equilibrium stud-ies. However, representative distribution coefficients among air, water, soil and non-aqueous phase liquid compartments in a simulated soil system could only be determined from multiphase batch equilibrium experiments. Air/soil partition-ing determinations showed that the mechanisms of compound vapor sorption by soils, and the effect of soil organic matter, clay content and soil mois-ture on this partitioning requires further evalua-tion. (Author's abstract) W90-06628

STRUCTURE-ACTIVITY RELATIONSHIP (SAR) APPROACH TOWARDS METABOLISM

OF PCBS IN MARINE ANIMALS FROM DIFFERENT TROPHIC LEVELS.

Nederlands Inst. voor Onderzoek der Zee, Texel. J. P. Boon, F. Eijgenraam, and J. M. Everaarts. Marine Environmental Research MERSDW, Vol. 27, No. 3/4, p 159-176, 1989. 4 fig, 1 tab, 41 ref.

Descriptors: *Bioaccumulation, *Biotransforma-tion, *Fate of pollutants, *Metabolism, *Mollusks, *Polychlorinated biphenyls, *Structure-activity re-lationships, *Wadden Sea, Macoma, Nereids, Water hirds

A qualitative structure-activity relationship (SAR) to estimate the influence of biotransformation on the degree of bioaccumulation of chlorinated bi-phenyl (CB) congeners under field conditions is presented. The CB patterns of different animal species from the western part of the Dutch Wadden Sea are used to illustrate the SAR. The CB pattern in a particular species was compared with that of the bivalve mollusc Macoma balthica. with that of the bivalve molluse Macoma balthica. It is assumed that no biotransformation occurs in this species, the CB pattern being determined only by equilibrium partitioning between tissues and the ambient water. When no significant differences in the pattern of a group of persistent congeners existed between a given species and Macoma balthica, significantly lower relative concentrations of congeners with vicinal hydrogen atoms in the meta-positions and para-positions in that species were attributed to biotransformation. The contribution of metabolizable congeners decreased in the order Macoma balthica > Nereis versicolor > Pleuronectes platessa, Haematopus ostralegis (male juvenile) > H. ostralegis (male (sub-)adult), Phoca vitulina. No significant differences in the patterns of persistent congeners were observed between the vitulina. No significant differences in the patterns of persistent congeners were observed between the latter four species. Phoca vitulina was the only species with a lowered relative concentration of CB-118. Biotransformation of congeners with a configuration possessing vicinal hydrogen atoms only in the o, m position and (at maximum) one ortho-chlorine may be significant from a toxicological standpoint, as a number of toxic congeners belong to this group. Since most of the data in this study are derived from wild organisms, the results are highly field relevant. (Author's abstract)

HYDROCARBON WEATHERING AND BIO-DEGRADATION IN A TROPICAL ESTUARINE ECOSYSTEM.

Museume National d'Histoire Naturelle, Paris (France). Lab. de Cryptogamie. Oudet.

Marine Environmental Research MERSDW, Vol. 27, No. 3/4, p 195-213, 1989. 8 fig, 4 tab, 22 ref.

Descriptors: *Biodegradation, *Depuration, *Estuarine environment, *Fate of pollutants, *Littoral zone, *Microbial degradation, *Oil, *Weathering, Indonesia, Mangrove swamps.

The weathering of a crude oil has been studied for a 12-month period in the intertidal zone of estuarine mangrove sediments of the Mahakam delta (East Kalimantan, Indonesia). Experimental parcels were polluted with an Indonesian crude oil, and the depuration of the sediments under the action of physical processes and microbial biodegradation was monitored over a 12-month period. The relative roles of physical removal and microbial biodegradation in the depuration of the experimental field have been determined. Physical processes were at first predominant, but only displaced the contaminant in the ecosystem and modification of the molecular structures and mineralization of of the molecular structures and mineralization of oil compounds was essentially achieved through the microbial degradation activity in the site. Some of the active microorganisms involved were isolated from sediment samples and identified. The dominant bacterial strains represented the genera Rhodococcus, Micrococcus, Bacillus, Pseudomonas and Acinetobacter, and the fungal strains represented Aspergillus and Trichoderma. The classical order in the biodegradability of the petroleum components was observed (i.e. n-alkanes)-isoalkanes>medium molecular weight polycyclic alkanes and aromatics) and the expected resistant or refractory compounds were also found (i.e. heavy of the molecular structures and mineralization of refractory compounds were also found (i.e. heavy

Sources Of Pollution-Group 5B

polycyclic alkanes and aromatics, steranes-terpanes, resins and asphaltenes). Biodegradation extent and rates were remarkably similar to those observed in analogous temperate ecosystems. Nitrogen deficiency was the main critical factor in the limitation of the biodegradation rate. The digning of the surface layer of the sediments, which did not increase biodegradation, should be avoided in such ecosystems. (Brunone-PTT) W90-06638

DISTRIBUTION OF TRACE METALS IN SOME REPRESENTATIVE FAUNA OF THE SOUTHERN BALTIC.

SOUTHERN BALTIC.
Akademia Medyczna, Gdansk (Poland). Dept. of
Analytical Chemistry.
P. Szefer, K. Szefer, and B. Skwarzec.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No.
2, p 60-62, February 1990. 2 tab, 13 ref.

Descriptors: *Bioaccumulation, *Path of pollut-ants, *Trace metals, Baltic Sea, Crustaceans, Fish, Heavy metals, Marine pollution, Mollusks, Poland.

Knowledge of the distribution of metals in isolated tissues of marine organisms is useful in the identification of specific organs that might be particularly sensitive accumulators of heavy metals. Tissue of the clam mollusk Mya arenaria, crustacean Mesidothea entomon, and the cod Gadus morhua, taken from Gdards Parv in the courters. Petric Sen from Gdansk Bay in the southern Baltic Sea, were from Gdansk Bay in the southern Battic sea, were analyzed for levels of iron, zinc, manganese, copper, lead, cadmium, cobalt, and nickel. The mantle and syphon of Mya arenaria, representing approximately 25 and 28 ppt of the total body weight, respectively, accounted for 96 ppt of the total Fe and Mn. The hepatopancreas of Mesical Personal Per total Fe and Mn. The hepatopancreas of Mesidothea entomon, representing only 2.4 ppt of the total body, contained 56 ppt of the total Cu, hence it is the principal gland responsible for accumulation of Cu in this crustacean tissues. In the fish Gadus morhua, high levels of Cd were observed in kidney and the pyloric caeca. Gills contained the highest concentrations of Pb, Co, Ni, and Cd; this may be attributed to the presence of adsorbed particulate matter on the gills rather than to active biological uptake of the metals. (Brunone-PTT) W90-06641

CHROMIUM FLUXES THROUGH MEX BAY INSHORE WATERS.

INSHORE WATERS. Alexandria Univ. (Egypt). Dept. of Oceanography. O. Aboul Dahab, A. N. Khalil, and Y. Halim. Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 2, p 68-73, February 1990. 4 fig. 5 tab, 14 ref.

Descriptors: *Bioaccumulation, *Chromium, *Egypt, *Estuarine environment, *Path of pollutants, Algae, Bays, Fish, Food chains, Mex Bay.

ants, Algae, Bays, Fish, Food chains, Mex Bay. Chromium, a toxic and potentially carcinogenic pollutant, is discharged into Mex Bay, Egypt from an agricultural drain (456 kg/day), a chlor-alkali plant (7 kg/day), and the flowing water from Alexandria harbor (41 kg/day). Elevated chromium concentrations in the bay waters have been measured. Superficial sediments and edible organisms from different trophic levels were collected and analyzed by graphite furnace atomic absorption spectrometry for their chromium content. No significant correlation was found between chromium concentrations and organic carbon in sediments. Cr concentrations and organic carbon in sediments. Cr concentrations in the bay sediments ranged from 42 microgram/g dry wt and 752 microgram/g dry wt with an average of 243 +/-213 microgram/g dry wt. No dignificant correlation was found between chromium concentration in marine organisms increased in the following order: Boops boops > mixed plankton > Mullus barbatus > Sardina pilchardus > Rhinobatus halavia > Ulva rigida > Enteromorpha intestinalis. Chromium did not undergo biomagnification in the marine food webs of the bay and may actually experience biodepletion from algae and crabs to fish. From the daily total mass emission of cation in the marine food wess of the bay and may actually experience biodepletion from algae and crabs to fish. From the daily total mass emission of chromium to the bay (504 kg/day), flushing of the bay to the open sea is responsible for the removal of about 60% and sedimentation within the bay 26%. The remaining 14% is assumed to be accurately actually the bay consistent first energy budget. mulated in the bay organisms. This energy budget

provides an approximation of the inputs, outputs, and of the standing stock of chromium in the water and biota of Mex Bay. (Author's abstract) W90-06642

ACCUMULATION POWER OF SOME BI-VALVE MOLLUSCS. Istituto Superiore di Sanita, Rome (Italy). Lab. di Igiene Ambientale. L. Bonadonna, L. Volterra, F. A. Aulicino, and L.

Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 2, p 81-84, February 1990. 1 fig, 5 tab, 10 ref.

Descriptors: *Bioaccumulation, *Fecal coliforms, *Microbiological studies, *Mollusks, *Path of pollutants, *Sewage bacteria, *Wastewater pollution, Aquaculture, Coastal waters, Microorganisms.

Several surveys were performed along the Italian coasts in marine areas in which molluses grow, to evaluate the hygienic quality of shellfish, shellfish rearing water, and sand beds. The samples were analyzed by the Most Probable Number (MPN) technique for fecal coliforms. The results of the analyses confirmed that different species of molluses show differential capacity to accumulate microorganisms and that microbiological water capacity for act and the procedure of the microbiological water. analysis does not always reflect the microbiologi-cal quality of the molluscs. Donax trunculus and cal quality of the molluscs. Donax trunculus and Ensis siliqua have a high capacity to concentrate microorganisms; Mytilus galloprovincialis reflects the variability of the environment where it feeds; Chamelea gallina has a poor accumulative capicity, at least, with regard to microbial enteric flora. Therefore, different species of molluscs may repre-sent a different risk as vectors of microbial diseases. (Author's abstract) W90-06644

FACTORS INFLUENCING THE UPTAKE OF TECHNETIUM BY THE BROWN ALGA FUCUS SERRATUS.

Institut Royal des Sciences Naturelles de Belgique, For primary bibliographic entry see Field 5A. W90-06645

DEGRADATION OF DIGESTED SEWAGE SLUDGE IN MARINE SEDIMENT-WATER MODEL SYSTEMS, AND FATE OF METALS. Essex Univ., Colchester (England). Dept. of Biol-

For primary bibliographic entry see Field 5D. W90-06646

METALS IN COASTAL WATERS OF SANTA CRUZ DE TENERIFE, CANARY ISLANDS. La Laguna Univ. (Spain). Dept. of Analytical

Chemistry.
C. Diaz, L. Galindo, F. G. Montelongo, M. S.

Carrechi, and F. X. Rius.

Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 2, p 91-95, February 1990. 2 fig, 6 tab, 15 ref.

Descriptors: *Canary Islands, *Coastal waters, *Heavy metals, *Path of pollutants, *Wastewater pollution, *Water pollution sources, Atomic absorption spectrophotometry, Sewer systems.

In order to ascertain the concentration of heavy In order to ascertain the concentration of heavy metals in the sea around the Canary Islands, a study was carried out in the coastal waters along Santa Cruz de Tenerife city. The coast was divided into three areas: one including the district of San Andres whose sewage outfalls directly into tidal waters through a discharge pipe; one including the city and docks with two storm drains discharging directly into the harbor some industries and factors. city and docks with two storm drains discharging directly into the harbor, some industries and factories; and, a third containing areas of heavy industrialization with four main outfalls. Samples were taken between 1984 and 1986 at 15 sampling stations and analyzed for heavy metals (lead, cadmium, iron, nickel, copper, zinc, and mercury) and trace metals. Determinations were carried out by atomic absorption spectrometry. Variations in heavy metal concentrations were statistically analyzed with regard to sampling date, sampling depth and season; no significant results were found

xcept for some samples taken near the main outfalls. In order to attempt the assignation of the main sources of seawater pollution, a factor analy-sis was carried out. In all cases, the results are not conclusive enough to assign the different origins to the heavy metal concentrations found. (Brunone-PTT)

PESTICIDES AND PCBS IN SOUTH CAROLINA ESTUARIES.

Fluor Daniel, Greenville, SC.

J. M. Marcus, and R. T. Renfrow.

Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 2, p 96-99, February 1990. 1 fig, 4 tab, 17 ref.

Descriptors: *Agricultural runoff, *Bioindicators, *DDT, *Estuaries, *Halogenated pesticides, *Polychlorinated biphenyls, *Sediment contamination, *South Carolina, *Water pollution sources, Baseline studies, Crabs, Oysters.

South Carolina is experiencing rapid growth in the coastal zone due to demands for industrial, urban and residential development. As these intense changes accelerate, the potential for input of pollutants to tidal creeks, rivers, and estuaries becomes greater. The broad-spectrum development is important to consider, since pesticides are transported to coastal waters not only by surface runoff from agricultural areas, but also by runoff from municipal, urban and resort areas and by discharges from wastewater treatment facilities. Basemunicipal, urban and resort areas and by discharges from wastewater treatment facilities. Baseline monitoring was performed for selected pesticides and polychlorinated biphenyls (PCBs) in oysters, crabs, and sediments from 16 locations within all major estuarine systems in South Carolina. The American oyster (Crassostrea virginica) and the blue crab (Callinectes sapidus) were chosen as biomonitors because of their abundance in estuaries, their ecological, recreational, and commercial importance, their different lifestyle (sedentary vs. mobile) and feeding (filter vs. active processing) characteristics and their different positions in the aquatic food web. Oysters were collected in March to coincide with annually high lipid and glycogen characteristics and their dilterent positions in the aquatic food web. Oysters were collected in March to coincide with annually high lipid and glycogen levels prior to spring spawn. Crabs were collected in July to coincide with elevated feeding and ranging activity. Sediments were collected at the same time as were the oysters. PCBs were found in oysters (50.8 micrograms/kg), crabs (90.6 micrograms/kg) and sediments (48.2 micrograms/kg). DDT was found in crabs (29.8 micrograms/kg) and oysters (5.44 micrograms/kg). DDE and alpha-BHC were found only in oysters (5.07 and 5.04 micrograms/kg respectively). The results indicate that South Carolina estuaries are not significantly contaminated with pesticides or PCBs within the scope of the parameters studied. This result will be important to environmental regulators and resource/policy administrators since the opportunity still exists in South Carolina to manage coastal development to preclude significant pesticide/PCB input and contamination rather than be forced to mitigate such occurrences after the fact. (Brunone-PTT) W90-06648 W90-06648

PLUTONIUM, LEAD-210, AND CARBON ISO-TOPES IN THE SAVANNAH ESTUARY: RI-VERBORNE VERSUS MARINE SOURCES.

Oak Ridge National Lab., TN. Environmental Sciences Div

For primary bibliographic entry see Field 2J. W90-06663

IMPORTANCE OF MICROALGAE IN THE BIODEGRADATION OF TRIBUTYLTIN IN ES-TUARINE WATERS.

Skidaway Inst. of Oceanography, Savannah, GA. R. F. Lee, A. O. Valkirs, and P. F. Seligman. Environmental Science and Technology ESTHAG, Vol. 23, No. 12, p 1515-1518, December 1989. 2 fig, 3 tab, 38 ref.

Descriptors: *Algae, *Antifoulants, *Biodegradation, *Estuaries, *Fate of pollutants, *Organotin compounds, *Pesticides, Algal growth, Coastal

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waters, Georgia, Organic compounds, Phytoplankton, Rivers, Water pollution control.

Low concentrations of tributyltin (TBT) (less than 5 nanograms per liter) were found in an estuarine river along the Georgia coast. Half-lives of TBT (both radiolabeled and unlabeled) added to these waters ranged from 3 to 13 days. Evidence sugwaters ranged from 3 to 13 days. Evidence suggesting that microalgae play an important role in TBT degradation in sunlit coastal waters included the following: (1) TBT degradation rates were high in light compared to dark degradation and there was no evidence of TBT photolysis; (2) (hydroxybutyl)tins and dibutyltin were the major degradation products in the light and by cultures of diatoms and dinoflagellates, while only dibutyl-tin was observed in the dark; (3) TBT degradation increased in sunlight when nitrate was added. Stimulation of algal growth may be of use in enclosed aquatic areas with organotins, since dense algal cultures can rapidly degrade these organome-tallic compounds. (Author's abstract) W90-06664

POLYCYCLIC AROMATIC HYDROCARBONS IN MARINE ORGANISMS FROM ITALIAN CENTRAL MEDITERRANEAN COASTS.

Naples Univ. (Italy). Dipt. di Farmacologia Speri-

R.A. Cocchieri, A. Arnese, and A.M. Minicucci. Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 1, p 15-18, January 1990. 1 fig, 2 tab, 18 ref.

Descriptors: *Bioaccumulation, *Italy, *Marine animals, *Path of pollutants, *Polycyclic aromatic hydrocarbons, Carcinogens, Coastal waters, Hydrocarbons, Marine biology, Marine environment, Mediterranean Sea, Pollutants, Toxicity.

The level of 16 polycyclic aromatic hydrocarbons (PAHs) was investigated in 5 shellfish and 14 fish along the coast of the Gulf of Naples. High-performance liquid chromatography analyses were carried out using a chromatographe quipped with a variable-wavelength untraviolet detector at 254 variable-wavelength untraviolet detector at 234 mm, a calculator/integrator, and a 25 x 4.6 mm column. The average total amount of PAHs in shellfish was 217 microg/kg wet wt, with a range 185-295 microg/kg and in fish species 94-1930 microg/kg wet wt. The total PAH levels found correspond to those of polluted areas. (Male-PTT)

TRANSPORT OF INCINERATED ORGAN-OCHLORINE COMPOUNDS TO AIR, WATER, MICROLAYER, AND ORGANISMS. Lund Univ. (Sweden). Dept. of Ecology. A. Sodergren, P. Larsson, J. Knulst, and C.

Bergqvist.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 1, p 18-24, January 1990. 7 fig, 1 tab, 33 ref.

Descriptors: *Chlorinated hydrocarbons, *Incineration, *Path of pollutants, *Water pollution sources, Air pollution, Industrial wastes, Marine environment, Marine organisms, Municipal wastes, Organic compounds, Polychlorinated biphenyls,

In a laboratory system designed to study the distri-bution of airborne emissions originating from sources such as incineration, the fates of PICs (products of incomplete combustion) of trichlor-oethylene and PCBs were followed. The airborne nces introduced over a body of water were depositied onto the surface of the water and became enriched in the surface microlayer. They were taken up by organisms in the subsurface water, resulting in an accumulation of PICs and polychlorinated biphenyls by fish in amounts up to 1000 to 1,000,000 times those measured in the water. A relationship existed between the concentrations of the organochlorine residues in the air and those in the microlayer and water. (Author's abstract) W90-06680

RELATIONSHIP BETWEEN METALS IN SEA-WATER AND METAL ACCUMULATION IN SHRIMPS.

Nantes Univ. (France). Lab. de Physiologie. A. Alliot, and M. Frenet-Piron. Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 1, p 30-33, Jauaryn 1990. 3 fig, 1 tab, 18 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Path of pollutants, *Shrimp, Cadmium, Copper, Lead, Marinas, Seawater, Water pollution effects,

Cadmium, copper, lead and zinc were analyzed Cadmium, copper, lead and zinc were analyzed both in sea water and in a shrimp Palaemon serratus, over a three year period. Samples were taken every month from the pleasure boat harbor of La Trinite sur-Mer in south Brittany, France. The results show a seasonal pollution in the sea-water during spring and summer, which has repercussions on the shrimps. Winter conditions lead to normal after a long period. (Author's abstract) W90-06682 W90-06682

DISTRIBUTION OF OIL-DEGRADING BACTE RIA IN THE NORTHWEST ARABIAN GULF. Basrah Univ. (Iraq). Marine Science Centre.

E.I. Hamilton. Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 1, p 38-40, January 1990. 1 fig, 1 tab, 13 ref.

Descriptors: *Bacteria, *Biodegradation, *Fate of pollutants, *Oil pollution, *Persian Gulf, Baseline studies, Cleanup operations, Hydrocarbons, Marine environment, Oil spills.

In this study, the density and identity of oil degrad-ing bacteria in water and sediment of the north-western Arabian Gulf were evaluated in order to establish baseline information for this part of the Arabian Gulf. The population of oil-degrading bacteria (ODB) were monitored over a period of bacteria (ODB) were monitored over a period of 13 months in a water body known as Khor Al-13 months in a water body known as Knor Al-Zubair. This estuarine lagoon is to the south-west of the port city of Basrah, Iraq with a length of about 40 kilometers, a width between 1 and 2 kilometers at high tide, with a navigational channel = 10-20 meters deep and a 3.2 meter tidal range. From May 1987 to May 1988, 234 samples of water and sediment were collected from three sampling stations 7 kilometers apart along the navigational channel of the lagoon. Surface water samples (10 centimeters deep) were collected and analyzed for water temperature, pH, and salinity. Oil-degrading bacteria were isolated on agar medium with I milliliter (liter to the negative 1) of Rumella crude milliliter (liter to the negative 1) of Runnelia crude oil added as a carbon source. No significant correlation was observed between water temperature, pH, salinity and the density of oil-degrading bacteria. Data from this study represent an environment with a low level and short history of oil pollution, with a low level and short mistory of oil pollution, indicated by the low level of hydrocarbons concentration in the region and complemented by the reduced densities of oil degrading bacteria recovered. (Author's abstract) W90-06684

METAL LEVELS IN A LEATHERBACK TURTLE.

TURILE. University Coll. of North Wales, Menai Bridge. School of Ocean Sciences. J. Davenport, and J. Wrench. Marine Pollution Bulletin MPNBAZ, Vol. 21, No.

1, p 40-41, Jan 1990. 1 tab, 11 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Turtles, *Turtles, Marine animals, *Path of pollutants, *Turtles, Aquatic animals, Arsenic, Cadmium, Jelly fish, Lead, Mercury, Nickel, Selenium, Zinc.

The leatherback turtle (Dermochelys coriacea) is the largest and most pelagic of living turtles. Since the species is so long-lived, has an impermeable integument and water-conserving renal system, the species appears to be an ideal indicator of the degree of contamination of the oceanic food web by accumulating materials such as heavy metals. Tissue samples were taken from turtles that suffocated in fishing nets and were analyzed for mercury and selenium by cold vapor atomic absorption spectrometry. All other metals except zinc were analysed by graphite furnace atomic absorption spectrometry using a L'vov platform. Zinc was

measured by flame atomic absorption spectrometry. Analytical quality control was achieved using TORT-1 Lobster Hepatopancreas from the National Research Council of Canada. For most heavy metals (mercury, cadmium, lead, zinc and nickel), the liver appeared to contain the highest levels; similar to other marine vertebrates. Most levels appeared to be below values reported in other literature, particularly cadmium where the concentration of the metal in the liver or hepatopancreas of marine animals is usually two orders of magnitude above that reported here. In most cases the subcutaneous blubber contained low levels of metals (particularly in the case of selenium and metals (particularly in the case of selenium and cadmium). However, arsenic was more concentratcadmium). However, arsenic was more concentrated in the blubber than in the liver or muscle. This observation is consistent with previous reports that arsenic may associate with polar lipids in organisms at lower trophic levels, and that this may subsequently be transferred to organisms at higher trophic levels as 'arsenolipid' complexes. (Author's abstract) abstract) W90-06685

POLLUTION OF HARBOUR SEDIMENTS BY HEAVY METALS.

Antwerpse Waterwerken (Belgium).
For primary bibliographic entry see Field 5G. W90-06687

HYDROCHEMISTRY AND POLLUTION STATUS OF SOME KASHMIR HIMALAYAN

LARES.
Kashmir Univ., Srinagar (India). Centre of Research for Development.
K. Koul, P. Zutshi, and K. P. Dubey.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 36, No. 1, P 21-28, 1989. 4 tab, 33 ref.

Descriptors: *Enrichment, *India, *Mountain lakes, *Water chemistry, *Water pollution sources, Agricultural runoff, Aquatic environment, Chemical composition, Domestic wastes, Effluents, Lakes, Trace elements, Water analysis.

Three Kashmir Himalayan lakes, Khanpur, Trigan, and Tilwan, situated in the northeast of Srinagar, and Tilwan, situated in the northeast of Srinagar, India were investigated for major ion and trace element content of their waters. The average chemical composition indicated a certain degree of enrichment which was related to effluent discharge from domestic sewage and agricultural runoff. Trace elements Mn and Pb were above the acceptable limits. The three aquatic environments exhibited different degrees of pollution. (Author's abstract) W90-06690

FATE OF SOME CRUDE OIL RESIDUES IN SEDIMENTS

Jyvaeskylae Univ. (Finland). Dept. of Chemistry. S. Sinkkonen. Chemosphere CMSHAF, Vol. 18, No. 11/12, p 2093-2100, 1989. 1 fig, 3 tab, 19 ref.

Descriptors: *Aromatic compounds, *Degrada-tion, *Fate of pollutants, *Marine sediments, *Oil pollution, *Path of pollutants, Anthracene, Ben-zenes, Dibenzothiophere, Leaching, Oil spills, Phenanthrene, Soil contamination.

The natural degradation of crude oil was followed in Finnish Archipelago shore sediments treated with fresh Russian crude oil at a rate of 10 kilograms of oil/sq m in October 1978. Degradation of grams of oil/sq in in October 1978. Degradation of oil residue compounds was analyzed in sediment samples taken from the 0-4 cm layer in 1979, 1980, 1981 and 1988. The non-polar aromatic fraction was analyzed by gas chromatography/mass spectrometry. The small amounts of residue in 1979 showed that only a small part of the oil contamina-tion had leached to sediment layer 0.5-4 cm during the first year. Small aromatic compounds such as naphthalene, biphenyl and fluorene were not found. Anthracene and phenanthrene were found in small amounts. The concentrations of alkyl substituted phenanthrenes were remarkable. In the samples from the year 1988, detectable amounts of alkyltrimethylbenzenes, anthracene and phenan-

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threne and alkyl substituted phenanthrenes were no longer present. Most aromatic crude oil compo-nents were biodegradable in sediment in a few years to undetectable levels. Dibenzothiophenes years to undetectable levels. Dibenzothiophenes were significantly more persistent than the other components studied. The present results strongly support the suggestions that aromatic compounds such as trimethylbenzene, anthracene, methylphenanthrene, dimethylphenanthrene, dimethylphenanthrene, dimethylphenen and trimethyldibenzothiophene in sediment are from crude oil pollution. Age of the pollution incident can be deduced from the ratios of the residues due to their different persistence in sediment. (Geiger-PTT) W90-06744

ORGANOCHLORINE COMPOUNDS AND BROMODIPHENYLETHERS IN LIVERS OF ATLANTIC COD (GADUS MORHUA) FROM THE NORTH SEA, 1977-1987.
Rijksinstituut voor Visserijonderzoek, Ijmuiden (Netherlands).

Netherlands). J. de Boer. Chemosphere CMSHAF, Vol. 18, No. 11/12, p 2131-2140, 1989. 2 fig, 5 tab, 18 ref.

Descriptors: *Bioaccumulation, *Chlorinated hydrocarbons, *Cod, *Ethers, *North Sea, *Path of pollutants, Chlordane, DDT, Dieldrin, Liver, Pesticide residues, Spatial distribution, Temporal dis-

Concentrations of organochlorine compounds and bromodiphenylethers have been measured in cod liver from the southern, central and northern North Sea since 1977. All analyses were performed using capillary column gas chromatography. For hexachlorobenzene, octachlorostyrene, dieldrin and bromodiphenylethers spatial trends were identified, with decreasing levels from the southern to the northern North Sea. Concentrations of DDT compounds, hexachlorocyclohexanes and chlordanes were found to be more uniformly distributed over the three areas. For all organochlorine compounds. danes were found to be more uniformly distributed over the three areas. For all organochlorine compounds with the exception of total DDT, decreasing time trends could be assessed. The German oxychlordane tolerance level is equaled or exceeded by the cod liver samples from all three areas in the North Sea of 1982/1983. Results for the other organochlorine compounds, with the exception of bromodiphenylethers for which tolerance levels are unknown, do not exceed these tolerance levels. (Geiger-PTT) W90-06745

DISTRIBUTION OF POLYCHLORINATED BI-PHENYLS IN WATER, SEDIMENT AND BIOTA OF TWO HARBOURS. National Water Research Inst., Burlington (Ontar-io). Lakes Research Branch. A. Mudroch, F. I. Onuska, and L. Kalas. Chemosphere CMSHAF, Vol. 18, No. 11/12, p 2141-2154, 1989. 6 fig, 6 tab, 24 ref.

Descriptors: *Benthos, *Bioaccumulation, *Heavy metals, *Lake Erie, *Lake Ontario, *Marine sediments, *Path of pollutants, *Polychlorinated biphenyls, Chlorinated hydrocarbons, Chromium, Copper, Fish, Isopods, Lead, Oligochaetes, Snails, Zinc.

The concentrations of individual polychlorinated biphenyl (PCB) homologues were determined by open tabular column gas chromatography in the water, sediments and biota collected from Hamilwater, sediments and biota collected from Hamilton Harbor, Lake Ontario, and Wheatley Harbor, Lake Erie, Canada. Concentrations of total PCBs ranged from 166 to 14,185 microgm/kgr (dry weight) in harbor sediments, and from 58.7 to 262.7 microgm/kgr (wet weight) in biota. Concentrations of lower chlorinated PCBs were greater in the water than in the sediments in both harbors. the water than in the sediments in both harbors. The concentration patterns of the homologues in the biota (oligochaetes, snails, isopods and fish) were more similar to those in the sediment than in the water in both harbors. The sediment, considered the biotic habitat, was more similar physically (i.e., particle size distribution) than chemically in the two harbors. Concentrations of metals (Zn, PC, u, and Cr) were greater in Hamilton Harbor than in Wheatley Harbor sediments. (Author's abstract)

TRACE-LEVEL ANALYSIS OF PHTHALATE ESTERS IN SURFACE WATER AND SUSPENDED PARTICULATE MATTER BY MEANS OF CAPILLARY GAS CHROMATOGRAPHY WITH ELECTRON-CAPTURE AND MASS-SELECTIVE DETECTION.

W90-06746

Rijkswaterstaat, Haren (Netherlands). Tidal Waters Div. For primary bibliographic entry see Field 5A. W90-06747

CHEMICAL STABILITY OF THE MUTAGENS 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE (MX) AND E-2-CHLORO-3-(DICHLOROMETHYL)-4-OXO-BUTENOIC ACID (E-MX).

Abo Akademi, Turku (Finland). B. Holmbom, L. Kronberg, and A. Smeds. Chemosphere CMSHAF, Vol. 18, No. 11/12, p 2237-2245, 1989. 3 fig. 3 tab, 18 ref.

Descriptors: *Degradation, *Fate of pollutants, *Mutagens, *Pulp wastes, Chlorination, Hydrogen ion concentration, Sulfites.

The isomerization and degradation in water of the mutagenic compound 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) and its geometric isomer, E-2-chloro-3-(dichloromethyl)-4-oxo-butenoic acid (E-MX) were studied at different pHs and temperatures in water containing added sulfite and sulfide ions. Both MX and E-MX occur in and sulfide ions. Both MX and E-MX occur in wood pulp chlorination liquors and chlorinated drinking water. The UV spectra of MX at various pH values revealed that MX undergoes a transformation, i.e. from ring to dissociated open chain form and vice versa, in the pH range 4.5-6. In the pH range of 5-9, the range of natural waters and drinking waters, MX disappeared most rapidly at Ph 6 and slowest at pH 8 both at 23 C and 4 C. The half life time of MX at 23 C was about 2.5 days at pH 6 but close to 6 days at pH 8. Isomerization to E-MX took place in the whole range 5-9. The isomerization was fastest at pH 6 and pH 5. The amount of E-MX exceeded the amount of MX after 6 days of storage at pH 6 and after 13 days at after 6 days of storage at pH 6 and after 13 days at pH 5. At pH 8-9 the isomerization to E-MX became less significant and other reactions leading to loss of MX dominated. E-MX isomerized to MX to loss of MX dominated. E-MX isomerized to MX completely and without losses at pH 2 in 12-13 days at 40 C. In the presence of sulfite gradual disappearance of MX was observed. The disappearance rate was slightly higher at pH 7 than at pH 5. The sulfide ions caused an even faster disappearance of MX than the sulfites. (Geiger-PTT) W90-06748

DISTRIBUTION AND FATE OF HALOGENAT-ED ORGANIC SUBSTANCES IN AN ANOXIC MARINE ENVIRONMENT.

Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemis-

K. Abrahamsson, and S. Klick. Chemosphere CMSHAF, Vol. 18, No. 11/12, p 2247-2256, 1989. 7 fig, 1 tab, 30 ref.

Descriptors: *Chlorinated hydrocarbons, *Fate of pollutants, *Fjords, *Path of pollutants, *Pulp wastes, Degradation, Marine sediments, Organic compounds, Spatial distribution, Water analysis.

The fate of chlorophenolics and halocarbons re-leased from a pulp and paper mill into the Idefjor-den, an anoxic fjord on the border of Norway and den, an anoxic fjord on the border of Norway and Sweden, was studied in water and sediment samples taken in June of 1988. The fate of low molecular halocarbons is mainly controlled by dilution and volatilization, whereas chlorophenolics are in addition exposed to dehalogenation, and in general have more complicated transportation mechanisms, including particle adsorption and sedimentation. The overall concentrations of chlorophenols and chlorguaiacols in the water samples were low. Dichlorophenols could not be detected and the guaiacols were only present at the two sampling stations close to the outlet. Outside the fjord the concentrations of chlorophenols did not decrease

to the same extent as the halocarbons. High back-ground levels of tetrachlorophenols from other pulp mills in the area are suspected. Chlorinated phenols and guaiacols could not be detected in the pnenois and guaracois count not be detected in the sediment samples. Sedimentation of chlorinated phenolics associated with solid organics seems likely, while dehalogenation of chlorophenols by anoxic marine sediments is also suspected. (Geiger-PTT W90-06749

PRELIMINARY REPORT ON THE ATRAZINE AND MOLINATE WATER SUPPLY CONTAMINATED IN ITALY.

Istituto Superiore di Sanita, Rome (Italy). Lab. di Igiene Ambientale. E. Funari, G. Acquafresca, F. Arca, M. Baldi, and

J. Bastianetti. Chemosphere CMSHAF, Vol. 18, No. 11/12, p 2339-2343, 1989. 3 fig, 2 tab, 15 ref.

Descriptors: *Atrazine, *Groundwater pollution, *Herbicides, *Italy, *Molinate, *Path of pollutants, *Water pollution sources, Agricultural chemicals, Drinking water, Leaching, Monitoring, Seasonal variation

A monitoring program was proposed by the Italian National Institute of Health and carried out by local laboratories to check the extent and intensity of the contamination by atrazine and molinate of water supplies of several Italian farming districts. The highest values of atrazine contamination were reported in Alessandria, Bergamo, Pavia and Vercelli. In the Lombardia region a clear correlation existed between the extent of corn cultivation and existed between the extent of configuration and attrazine groundwater contamination of public wells. Permeable soils and the presence of high water table also coincided with groundwater contamination with attrazine. In the Piemonte region the atrazine contamination of well water was strongly season-dependent being higher in June than in August. Molinate contamination of well than in August. Molinate contamination of well water was limited to the districts where its use was considerable. Vercelli and Pavia Districts, the highest producers of rice in Italy, showed the highest extent and intensity of molinate pollution of well water. (Geiger-PTT)

STREAM LEVELS OF AGRICHEMICALS DURING A SPRING DISCHARGE EVENT.

Nebraska Univ., Lincoln. Conservation and

R. F. Spalding, and D. D. Snow. Chemosphere CMSHAF, Vol. 19, No. 8/9, p 1129-1140, 1989. 7 fig, 1 tab, 19 ref.

Descriptors: *Agricultural chemicals, *Agricultural runoff, *Nonpoint pollution sources, *Pesticides, *Stream pollution, Alachlor, Atrazine, Cyanazine, Insecticides, Nitrates, Path of pollutants, Suspended sediments, Triazine herbicides.

Levels of agrichemicals were monitored during a spring runoff event in Shell Creek, an eastern tributary of the Platte River, which drains a 700 sq tributary of the Platte River, which drains a 700 sq km watershed of predominantly row-cropped corn. Discharge during the runoff event ranged from 19 to 781 cu ft/sec. Maximum levels of atrazine, cyanazine, and alachlor of 89, 76, and 46 microgm/L, respectively, occurred prior to the peak in stream discharge. Other residues detected at low concentrations during the peak in stream discharge include the herbicides butylate, EPTC, metolachlor, metribuzin, propachlor, and trifluralin, and one insecticide, disulfoton. Suspended sediment levels (maximum = 19.7 gm/L) correlated with pesticide levels, while nitrate-N concentrations (maximum = 6.3 mg/L) did not. (Author's abstract) abstract) W90-06752

EFFECT OF NATURAL LIGANDS ON TRACE

Water Research Centre, Medmenham (England). M. Gardner, and A. Gunn. Chemosphere CMSHAF, Vol. 19, No. 8/9, p 1251-1259, 1989. 3 fig, 20 ref.

Group 5B-Sources Of Pollution

Descriptors: *Copper, *Mathematical models, *Model studies, *Path of pollutants, *Trace metals, Dissolved solids, Fate of pollutants, Heavy metals, Natural waters, Organic matter, Particulate matter, Seawater, Sludge disposal, Suspended solids,

The partitioning of environmental contaminants was modeled mathematically to study the fate and speciation of trace metals, and in particular copper, contained in sewage sludge which is disposed of at sea. The ligands for copper can be derived from the sludge itself or can be present naturally in seawater. The model allows each of these sources seawater. The model allows each of these sources to be varied independently although the same stability constant is used for ligand-metal complexes regardless of source. Model parameters such as true partition coefficient, ligand concentration in sludge, metal-ligand complex stability constant, metal concentration in sludge, metal-ligand complex stability constant, metal concentration in sewage sludge, sludge suspended solids, and dilution ratio were chosen on the basis of what is known concerning copper the basis of what is known concerning copper complexation in seawater and the composition of what might be regarded as the component of sewage sludge which remains suspended in sea-water. Two separate competing effects were ap-parent from the model. The first was the increase in observed/measured partition coefficient as dilu-tion was increased. In the case of sewage sludge the variation of observed partition coefficient wight the variation of observed partition coefficient with dilution was explicable as a product of complexation. The value for the partition coefficient at highest dilution is nearest to the true value. At lower dilutions, the effect of ligands in the dissolved phase is to increase the proportion of metal in solution and hence to depress the partition coef-ficient. The second effect amounted to a titration of metal derived from the added solid phase with ligands naturally present in solution. For the most strongly complexing ligands, the consequence of this was to reduce the observed value of the partition coefficient at higher dilutions to a value very much less than its theoretical level. In combination, these two effects tended to lead to the under-estimation of the value of the partition coefficient. (Geiger-PTT) W90-06754

FUGACITY AND PHASE DISTRIBUTION OF MIREX IN OSWEGO RIVER AND LAKE ON-TARIO WATERS.

TARIO WATERS.
State Univ. of New York at Syracuse. Coll. of
Environmental Science and Forestry.
C. Yin, and J. P. Hassett.
Chemosphere CMSHAF, Vol. 19, No. 8/9, p 12891296, 1989. 6 fig, 2 tab 18 ref. NOAA Office of Sea
Grant NA84AADSG021.

Descriptors: *Adsorption, *Lake Ontario, *Mirex, *Oswego River, *Path of pollutants, Dissolved organic carbon, Dissolved solids, Organic matter, Particulate matter, Temperature effects

The phase distribution of mirex, a hydrophobic toxicant, was examined in Oswego River and Lake Ontario waters. A dynamic headspace method was applied to determine the fugacity and free disapplied to determine the fugacity and free dis-solved concentration of mirex in water. Solvent extraction was used to determine the total and particulate adsorbed concentration. In the water phase, 8% to 22% was free dissolved with the remainder bound to dissolved organic matter. In most cases, the particulate fraction was small. Mirex fugacity increased with water temperature. The partition coefficients of mirex with natural dissolved organic carbon (DOC) were 900,000 to 1.500,000. and decreased with increasing DOC 1,500,000, and decreased with increasing DOC concentration. A consideration of binding is suggested in the environmental modeling of hydrophobic compounds. (Author's abstract) W90-06756

DISTRIBUTION OF POLYCHLORINATED BI-PHENYL CONGENERS AND HEXACHLORO-BENZENE IN DIFFERENT TISSUES OF DAB (LIMANDA LIMANDA) FROM THE NORTH

Hamburg Univ. (Germany, F.R.). Inst. fuer Bio-

chemie und Lebensmittelschemie.
R. Knickmeyer, and H. Steinhart.
Chemosphere CMSHAF, Vol. 19, No. 8/9, p 1309-

1320, 1989, 5 fig. 3 tab, 22 ref.

Descriptors: *Bioaccumulation, *Chlorinated aromatic compounds, *Fish, *North Sea, *Path of pollutants, *Polychlorinated biphenyls, Aromatic compounds, Chlorinated hydrocarbons, Lipids,

The analysis of polychlorinated biphenyl (PCB) patterns in livers of immature dabs, livers of mature male as well as livers and ovaries of mature female specimens, revealed significant differences in the accumulation of single PCB congeners. Each of the examined tissues exhibited a specific PCB pattern. Lipid content or geographic origin did not decisively influence the qualitative composition of PCB-compounds but only their concentra-tion. Pentachlor-to decachlorbiphenyls with 4,4'chlorine substitution or with three ortho-chlorines are accumulated in the liver of adult dabs. Depleare accumulated in the liver of adult dabs. Depletion of lipids from the female liver during ovary maturation is an important excretory pathway of PCBs and hexachlorobenzenes during spawning. The 2,3,4-chlorine substitution on an aromatic ring is responsible for the phenomenon of preferential transfer of hexachlorinated aromatic chemicals from female livers to ovaries. (Author's abstract) W90-06757

DISTRIBUTION OF PCB CONGENERS IN SEDIMENTS OF THE OTONABEE RIVERRICE LAKE SYSTEM, PETERBOROUGH,

CANADA.
Trent Univ., Peterborough (Ontario). Environmental and Resource Studies Program.
M. L. Ferguson, and C. D. Metcalfe.
Chemosphere CMSHAF, Vol. 19, No. 8/9, p 1321-1328, 1989. 4 fig, 16 ref.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *Sediment contamination, Canada, Fluvial sediments, Lake sediments, Little Lake, Otanabee River, Rice lake, Spatial distribution, Suspended sediments, Water pollution sources.

Samples of sediment from a river-lake system near Samples of sectiment from a river-take system near Peterborough, Canada were analyzed for poly-chlorinated biphenyl (PCB) congeners by both packed column and capillary column gas chromatography. Sediments were collected in the deposi-tional zone of Little Lake, at 3 sites along the Ottonabee River, and at 4 sites in Rice Lake be-tween October 1985 and February 1986 using a Kajak-Brinkhurst corer. Samples were prepared by soxhlet extraction for Little Lake sediments and by sonication extraction for Otonabee River and Rice Lake sediments. Parells of the Company of the Comp sonication extraction for Otonabee River and Rice Lake sediments. Results showed that sediment in Little Lake, within the city of Peterborough, is acting as a source of contamination for down-stream regions. The deposition zone in Little Lake had the highest level of PCB contamination (ap-proximately 5 ppm), and areas of deposition down-stream of Little Lake (Wallace Point and Otonabee stream of Little Lake (Wallace Point and Otonabee River mouth) had reduced but significant levels (> 1 ppm) of PCBs. Analysis of a core sample from Little Lake indicated that PCB contamination in the deposition zone extended from the surface to at least 30 cm below the sediment-water interface. Surface sediments did not contain lower concentrations of PCBs then depend continued PCB. Surface sediments that not contain lower concentrations of PCBs than deeper sediments. PCB levels were below packed column detection limits in the rich organic sediments cored at the mouth of the Indian River in the northeast area of Rice Lake suggesting that this drainage system is not a source of PCBs. Comparisons of concentrations of differ-ent PCB congeners showed that higher proportions of more chlorinated congeners occur as dis-tance downstream increases. The homogeneity of PCB congener patterns throughout the river system suggests that microbial degradation is not a major fate process in this system. (Geiger-PTT) W90-06758

HALOGENATED ORGANIC COMPOUNDS FOUND IN SHRIMP FROM THE CALCASIEU ESTUARY.

ESILVARY, McNeese State Univ., Lake Charles, LA. H. E. Murray, and J. N. Beck. Chemosphere CMSHAF, Vol. 19, No. 8/9, p 1367-1374, 1989, 3 fig. 1 tab, 16 ref. U.S. Department of Energy Grant DE-FG01-83EP31111.

Descriptors: *Bioaccumulation, *Calcasieu Estuary, *Halogenated hydrocarbons, *Louisiana, *Path of pollutants, *Shrimp, Chlorinated aromatic compounds, Estuaries, Hexachlorobutadiene, Organic compounds.

The Calcasieu Estuarine System serves as an important source of shrimping for southwest Louisiana. Because of the economic importance of this ana. Because of the economic importance of this setuarine system, shrimp (Penaeus settlerus and Penaeus aztecus) were collected throughout the Calcasieu River/Lake Complex and analyzed for synthetic halogenated compounds by gas chromatography/mass spectrometry. Results of pooled samples collected at six stations showed that consamples collected at six stations snowed that con-centrations of halogenated compounds varied widely throughout the estuarine system. Concen-trations of total halogenated compounds in shrimp tissue were highest in the upper portion of the estuarine system. Hexachlorobutadiene was found estuarine system. Hexachlorobutadiene was found in shrimp tissue at station D (Bayou d'Inde) at 18.59 nanograms/gm; at station I (Ship Channel) at 1.33 and 19.95 nanogram/gm; at station N (north end of Calcasieu Lake) at 2.09 and 61.11 nanograms/gm; and at station S (south end of Calcasieu Lake) at 1.13 nanogram/gm. The concentration of hexachlorobutadiene measured in shrimp collected hexachlorobutadiene measured in shrimp collected at station N during August 1988 exceeded the Department of Health and Human Resources emergency guidelines. Hexachlorobenzene was found in shrimp tissue at station D at 15.74 nanograms/gm; at station I at 6.84 nanograms/gm; at station N at 2.36 and 20.94 nanograms/gm; at station N at 0.44 nanograms/gm. The hexachlorobenzene concentrations detected in shrimp tissue in this study did not exceed the Louisiana Department of Health and Human Resources emergency guidelines. (Geiger-PTT) W90-06759

3H-THYMIDINE INCORPORATION: PRELIM-INARY INVESTIGATIONS OF A METHOD TO FORECAST THE TOXICITY OF CHEMICALS IN BIODEGRADABILITY TESTS.

Vandkvalitetsinstitutet, Hoersholm (Denmark). For primary bibliographic entry see Field 5C.

MODELLING THE ENVIRONMENTAL DISTRIBUTION OF NONPOLAR ORGANIC COMPOUNDS: THE INFLUENCE OF DISSOLVED ORGANIC CARBON IN OVERLYING AND IN-TERSTITIAL WATER.

Drexel Univ., Philadelphia, PA. Environmental G. Caron.

ere CMSHAF, Vol. 19, No. 10/11, p Chemosphere CMSHAF, V 1437-1482, 1989. 2 tab, 23 ref.

Descriptors: *Lindane, *Model studies, *Path of pollutants, *Polychlorinated biphenyls, *Spatial distribution, Adsorption, Dissolved organic distribution, Adsorption, Dissolved organic carbon, Interstitial water, Organic matter, Particulate matter. Sediments.

The partitioning of nonpolar compounds among sediment solids, interstitial water, and dissolved organic carbon in overlying and interstitial waters of an aquatic system was studied using column equilibration techniques. The equilibrium distribution relationships for these environmental compartments were incorporated into the equilibrium partition. ments were incorporated into the equilibrium parti-tioning model, CEPAC, developed in 1983. The CEPAC model was modified to include interstitial waters as environmental compartments. The environmental behavior of two test compounds, 22,4,4-tertachlorobiphenyl (TecBp) and lindane was predicted using the standard CEPAC pond model and the model revised to include dissolved organic carbon (DOC), interstitial water DOC, give extition with the control of the control o and interstitial water as environmental compartments. Default values for all standard CEPAC parameters were used. The default value for sediparameters were used. The default value for sedi-ment organic carbon content in the standard model is 4%. Overlying water DOC concentration was input as 3 mg/L while 30 mg/L was used for interstitial water DOC concentration. The stand-ard CEPAC model predicted that 94% of the TeCBP would be bound to the organic carbon of the sediment and most of the rema

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be in the water column. When binding of the be in the water column. When binding of the compound to DOC in overlying and interstitial water is considered, only 64% of the compound would be predicted to partition to the sediment, while 22% would be bound to DOC in the pore while 22% would be bound to DOC in the pore water. This prediction suggests that a considerable amount of the compound may be available for transport via diffusion in the interstitial water. The standard model predicts that this fraction of the chemical would be partitioned to sediment particulate matter. The inclusion of the three new compartments in the model had little effect on the predicted distribution of lindane. Less than 1% of the compound is predicted to be associated with DOC in the water column in both scenarios. Using the revised model, only 1.3% of the lindane was predicted to associate with interstitial water DOC. (Geiger-PTT) predicted to as (Geiger-PTT) W90-06761

DISTRIBUTION OF ALIPHATIC, AROMATIC AND CHLORINATED HYDROCARBONS IN MUSSELS FROM THE SPANISH ATLANTIC COAST (GALICIA): AN ASSESSMENT OF POL-LUTION PARAMETERS

LUTION PARAMETERS.
Instituto de Quimica Bio-Organica, Barcelona (Spain). Dept. of Environmental Chemistry.
M. Soler, J. O. Grimalt, J. Albaiges, J. Mendez,

and M. Marino. and M. Marino. Chemosphere CMSHAF, Vol. 19, No. 10/11, p 1489-1498, 1989. 4 fig, 2 tab, 12 ref.

Descriptors: *Aromatic compounds, *Bioaccumulation, "Chlorinated hydrocarbons, "Mussels, "Path of pollutants, "Pollutant identification, Chemical analysis, Coastal waters, Estuaries, Polychlorinated biphenyls, Spain, Spatial distribution.

Mussel populations collected in a suite of heavily polluted to non-polluted estuarine systems of the northwest Spanish Atlantic Coast (Galicia) were analyzed for alkanes + alkenes (I), monocyclic aromatics and polychlorinated biphenyls (II), and polycyclic aromatics (III). Using gas chromatography-lame ionic detection, gas chromatography-electron capture detection gas chromatography-electron capture detection gas chromatography-electron capture solved components of fractions I and II are pre-dominated by petrogenic hydrocarbons. Ultravio-let-fluorescence is also useful for the measurement let-fluorescend m contributions in fraction II, although a standard better than chrysene should be devel-oped for quantitation. The unresolved hydrocaropen for quantization. The unresolved hydrocarbons of fraction III correspond to a mixture of petrogenic and pyrolytic sources. Finally, the polychlorobiphenyls do not show any correlation with petrogenic or pyrolytic pollutant sources. (Author's abstract) W90-06762

SCREENING OF CHEMICALS FOR ANAERO-BIC BIODEGRADABILITY.
European Chemical Industry Ecology and Toxi-cology Centre, Brussels (Belgium).
R. R. Birch, C. Biver, R. Campagna, W. E.
Gledhill, and U. Pagga.
Chemosphere CMSHAF, Vol. 19, No. 10/11, p
1527-1550, 1989. 2 fig. 7 tab, 11 ref, append.

Descriptors: *Anaerobic digestion, *Biodegrada-tion, *Fate of pollutants, *Microbial degradation, Anaerobic conditions, Carbon, Performance eval-uation, Simulation analysis, Sludge.

A test method for the assessment of anaerobic biodegradability was developed by screening a number of methods and key parameters involved in the biodegradation process such as concentration of test compound, inoculum concentration and pretreatment, digester design and media composition. The recommended technique requires only a knowledge of the carbon content of the chemical being tested, and is applicable to poorly soluble compounds. Digestion takes place in pressure-controlled vials at 35 +/-2 C with a pH of 7 +/-0.2. The test material may be dosed in the form of a solution, suspension, emulsion or solid so that the

volume added is a maximum of 5% of the total liquid volume. The final concentration of the test substance should be in the range of 20-50 mg C/L. In the absence of inhibition to digesting microbes, higher concentrations can be used. Gas pressure, and pH should be monitored throughout the digestion period. Equations for final determination of carbon content and biodegradation are provided. A separate determination of the dissolved inorganic carbon in the digested liquor eliminates the need for any correction for the solubility of carbon dioxide. Washing the sludge used to inoculate the tests improves the precision of the method by reducing the background gas and dissolved inorganic carbon production. Inter-laboratory investigations showed that compounds exhibiting positive degradation results (5-60% degradation) have a precision of approximately 15% with respect to the 95% confidence range of the mean biodegradation rate. (Geiger-PTT)

USE OF COMPOSITED SAMPLES TO OPTIMIZE THE MONITORING OF ENVIRONMENTAL TOXINS.

MENIAL IOXINS.

Jyvaeskylae Univ. (Finland). Dept. of Chemistry.

J. Passivirta, and R. Paukku.

Chemosphere CMSHAF, Vol. 19, No. 10/11, p
1551-1562, 1989. 1 fig. 5 tab, 7 ref.

Descriptors: *Chlorinated hydrocarbons, *Herring, *Monitoring, *Path of pollutants, *Phenols, *Pollutant identification, *Toxicology, Benzenes, Chlordane, Cost analysis, DDD, DDE, DDT, Lindane, Optimization, Pesticides, Polychlorinated biphenyls, Spatial distribution, Tissue analysis.

A procedure of analyzing composited samples based on predicted laboratory variance to perform an environmental toxin monitoring program with an environmental toxin monitoring program with optimal costs is experimentally tested. A single population (one catch) of herring from the Eastern Gulf of Finland was analyzed for organochlorines as homogenates of individuals and composites of three, five and eight specimens. Altogether 54 samples (homogenates) were analyzed. Twelve of the samples were analyzed twice to get duplicate values for calculation of the laboratory variance. The results to test the optimizing theory were obtained for 2,4,6-trichlorophenol, alpha-hexachlorocyclohexane, lindane, hexachlorobenzene, DDE, DDD, DDT, alpha-chlordane, trans-nonachlor and PCB. Distribution of the contents was found and PCB. Distribution of the contents was found to be lognormal except the fat contents was found to be lognormal except the fat contents which were normally distributed. Laboratory variance increased nearly exponentially with decreasing mean. Optimization procedure gave satisfactory results for nearly all residues measured. Calculated saving of costs in case of chlorohydrocarbon monitoring from the studied herrings was 53.5% when optimized composite sampling was used instead of analyzing individual specimens. (Author's abstract) W90-06764

BIOMAGNIFICATION BY AQUATIC ORGA-

NISMS: A PROPOSAL.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
D. W. Connell.

Chemosphere CMSHAF, Vol. 19, No. 10/11, p 1573-1584, 1989. 2 fig, 3 tab, 16 ref.

Descriptors: *Bioaccumulation, *Biological magnification, *Model studies, *Path of pollutants, Aquatic animals, Food chains, Lipids, Salmon, Theoretical analysis, Trout.

The transfer of persistent lipophilic compounds The transfer of persistent lipophilic compounds from food to aquatic biota (the biomagnification process) was interpreted on the basis of partitioning between food in the gastrointestinal tract and the circulatory fluid, body lipids. A theoretical derivation, based on equilibrium conditions, suggests that the Biomagnification Factor (body concentration/food concentration) is independent of, or weakly dependent, on the octanol to water partition coefficient, and becomes unity for all compounds when expressed on a limit weight basis. compounds when expressed on a lipid weight basis. The available experimental data are generally in accord with this interpretation. The theory is cor-

roborated with biological magnification data from salmon and trout. (Author's abstract) W90-06765

INTERACTION BETWEEN POLYCHLORI-NATED BIPHENYLS AND MARINE HUMIC SUBSTANCES. DETERMINATION OF ASSO-CIATION COEFFICIENTS.

Alfred-Wegener-Inst. fuer Polarforschung, Bremerhaven (Germany, F.R.). R. Lara, and W. Ernst. here CMSHAF, Vol. 19, No. 10/11, p Chemosphere CMSHAF, Vol. 19 1655-1664, 1989. 4 fig, 2 tab, 29 ref.

Descriptors: *Chemical interactions, *Fate of pol-lutants, *Humic substances, *Path of pollutants, *Polychlorinated biphenyls, Adsorption, Bioavai-lability, Chemical analysis, Chemical properties, Dissolved solids, Organic carbon, Solubility.

The association coefficients (Kh) for 26 polychlorinated biphenyl (PCB) congeners and marine humic substances were determined at different humic subsubstances were determined at different nume sub-stances concentrations (5, 10, 20 and 40 mg of dissolved organic carbon/L). The humic sub-stances used in the experiments were isolated from waters of the German Bight. The experimental approach was based on the fact that, in the presence of dissolved humic substances, the extent of adsorption of lipophilic compounds to glass is sig-nificantly diminished. Kh was determined by measuring the fraction of added PCBs adsorbed to glass in a reference solution without humic substances. and the same in the presence of known concentrations of humic substances. The results for Kh were correlated with different properties and structural characteristics of the individual PCB congeners. Kh values correlated significantly with solubility. octanol-water partition coefficients, and the molecular total surface area of PCBs. Overall, Kh ined with the degree of chlorination of PCBs. Within groups of isomers, Kh decreased in general with increasing number of ortho-chlorines. Meta-substitution proximate to ortho-chlorines tended to produce a decrease in Kh. Kh also decreased at increasing humic substances co trations. (See also W90-06768) (Geiger-PTT)

MODELLING ASSOCIATION OF HIGHLY CHLORINATED BIPHENYLS WITH MARINE HUMIC SUBSTANCES.

Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Meteorologie und Klima-

A. Sabljic, R. Lara, and W. Ernst. Chemosphere CMSHAF, Vol. 19, No. 10/11, p 1665-1676, 1989. 1 fig, 2 tab, 43 ref.

Descriptors: "Fate of pollutants, "Humic substances, "Model studies, "Molecular structure, "Path of pollutants, "Polychlorinated biphenyls, Adsorption, Chemical analysis, Chemical properties, Chlorinated hydrocarbons, Organic carbon, Organic sealorisms Quantitative analysis

Molecular connectivity indices and other topological properties of organic molecules were tested and compared with existing models, regarding their ability to describe the association between PCBs and dissolved marine humic substances. model is derived which accounts for almost 99% of the variation in the association coefficients de termined in a previous study. From the QSAR analysis, the size of PCB molecules accounts for the majority of quantitative differences in their association with humic substances. This relationship is quadratic and increases until the maximum is reached. The structural feature of secondary importance is the degree of ortho substitution. The created model, when compared with existing QSAR models for PCBs association with humic substances, shows superior performance in accuracy and future applications. (See also W90-06767) eiger-PTT)

Group 5B-Sources Of Pollution

BIOTRANSFORMATION OF HEXACHLORO-BENZENE IN THE BLUE MUSSEL (MYTILUS

Alfred-'Vegener-Inst. fuer Polarforschung, Bre-Alfred-wegener-inst. Tuer Polarforschung, Bremerhaven (Germany, F.R.).

I. Bauer, S. Weigelt, and W. Ernst.
Chemosphere CMSHAF, Vol. 19, No. 10/11, p. 1701-1707, 1989. 3 fig., 1 tab, 11 ref.

Descriptors: *Biotransformation, *Chlorinated aromatic compounds, *Fate of pollutants, *Mussels, *Mytilus, *Pesticide residues, Benzenes, Bioaccumulation, Metabolites, Mollusks.

Metabolic products were isolated from blue mus-sels, Mytilus edulis, after exposure to C14-labeled and nonradioactive hexachlorobenzene (HCB) for could be identified by gas chromatography-mass spectrometry. From S(pentachlorophenyl)thioglycolate, no significant amounts of pentachlorothioanisole were formed within a 16 day-exposure period so that this metabolite was not considered to be of importance in the biodegradation pathway of HCB. (Geiger-PTT) W90-06769

HEAVY METALS IN WATER, SEDIMENT AND INVERTEBRATES FROM RIVERS IN EASTERN ENGLAND. ESSEX Univ., Colchester (England). Dept. of Biol-

ogy. N. A.-E. Barak, and C. F. Mason. Chemosphere CMSHAF, Vol. 19, No. 10/11, p 1709-1714, 1989. 1 fig, 2 tab, 17 ref.

Descriptors: *Bioaccumulation, *Cadmium, *Heavy metals, *Lead, *Mercury, *Sediment contamination, England, Invertebrates, Path of pollutants, River sediments, Seasonal variation.

Concentrations of Hg, Cd, and Pb were measured in water, sediment and invertebrate samples from sites upstream and downstream of towns on two rivers in eastern England. Metal levels in water and sediment were higher in downstream sites, but there were no clear gends, in restel, in inceptate and sediment were higher in downstream sites, but there were no clear trends in metals in invertebrates between the sites. Seasonal changes in metals concentrations in Asellus, Sigara and Limaea were investigated. There were no seasonal trends in levels of Hg. At all sites there was an increase in levels of Cd in Sigara during summer, peaks ranging between 0.26 mg/kg and 0.35 mg/kg. Levels of Pb increased at all sites during the mg. Levels of Po increased at all sites during the summer in Sigara, peaks ranging from 0.28 mg/kg to 0.76 mg/kg. Po concentrations were greatest in autumn in Limnaea at all sites, peaks ranging from 1.11 mg/kg to 3.49 mg/kg. (Geiger-PTT) W99.06770

EFFECT OF SLUDGE TREATMENT ON THE ORGANIC CONTAMINANT CONTENT OF SEWAGE SLUDGES.

Lancaster Univ. (England). Inst. of Environmental and Biological Sciences. For primary bibliographic entry see Field 5D. W90-06771

TOXICOKINETICS OF SELECTED POLYCY-CLIC AROMATIC HYDROCARBONS IN RAIN-BOW TROUT FOLLOWING ROUTES OF EXPOSURE. DIFFERENT

Simon Fraser Univ., Burnaby (British Columbia).
Environmental Toxicology Program.
C. J. Kennedy, and F. C. P. Law.
Environmental Toxicology and Environmental Toxicology and ETOCDK, Vol. 9, No. 2, p 133-139, 1990. 3 fig, 5 tab. 21 ref.

Descriptors: *Bioaccumulation, *Metabolism, *Path of pollutants, *Polycyclic aromatic hydro-carbons, *Toxicity, *Trout, Adsorption, Biological studies, Excretion, Fluorene, Model studies, Naphthalenes, Pyrene, Tissue analysis.

The toxicokinetics and bioavailabilities of 2-meth-ylnaphthalene (2-MN), fluorene and pyrene were studied in rainbow trout (Salmo gairdneri) implantstudied in rainbow trout (Salmo gairdner) implanti-ed with an indwelling cannula in the dorsal aorta. After intraarterial injection of one of the polycy-clic aromatic hydrocarbons (PAHs) (10 mg/kg) to trout, chemical concentration in the blood was found to decline triphasically with time. The terminal half-lives of elimination from the blood for 2-MN, fluorene and pyrene were 9.6, 10.5 and 12.8 hr, respectively. The toxicokinetics of the PAHs in MN, fluorene and pyrene were 9.6, 10.5 and 12.8 hr, respectively. The toxicokinetics of the PAHs in trout were best described by a three-compartment open model with the central compartment and the deep peripheral compartment representing the blood and fatty tissues of trout, respectively. The PAHs were metabolized by trout mainly to water-soluble metabolites which were excreted into the solution metaconities which were excreted into the urine and bile. When trout were exposed to water containing 2-MN, fluorene or pyrene (0.5 mg/L), the chemical was detected almost immediately in the blood. The apparent bioavailabilities of 2-MN, fluorene and pyrene in trout were 20, 36 and 35%, respectively. In contrast, little or no unchanged chemical was detected in the blood of trout followor pyrene (50 mg/kg). These results indicate that the PAHs are absorbed systemically by trout via the branchial route at rates much faster than that of the oral route. (Author's abstract)

PREDICTION OF CONTAMINANT ACCUMULATION BY FREE-LIVING ORGANISMS: APPLICATIONS OF A SIGMOIDAL MODEL.

Savannah River Ecology Lab., Aiken, SC. I. L. Brisbin, M. C. Newman, S. G. McDowell, and E. L. Peters.

Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 2, p 141-149, 1990. 2 fig, 1 tab, 39 ref. DOE Contract DE-AC09-76SROO-

Descriptors: *Bioaccumulation, *Fish, *Model studies, *Path of pollutants, *Turtles, *Waterfowl, Cesium radioisotopes, Depuration, Kinetics, Mer-

The accumulation of contaminants by free-living organisms has traditionally been determined with permutations of the classic deterministic model which relates rate of change of contaminant concentration over time to contaminant concentration in the organism at equilibrium and elimination or depuration constants. However, studies utilizing a variety of species and exposure scenarios now sug-gest that significant deviations may occur from this gest that significant deviations may occur from this classic form. In many cases noted to date, these deviations have involved a sigmoidal pattern of accumulation. While there may be no one single causal mechanism responsible for the expression of such a pattern in all cases studied, the application of a flexibly shaped Richards sigmoidal model can improve goodness of fit to the data relative to the classic model form. The Richards model was used to model the accumulation of Cs-137 by free-living American coots (Fulica americana) and yellow-American coots (runca americana) and yenow-bellied turtles (Pseudemys scripta), and Hg accu-mulation by mosquitofish (Gambusia affinis). While the classic model tended to overestimate Cs-137 levels in turtles and coots initially (up to approximately 25 days) after release to uncontaminated environments and then underestimate Cs-137 levels thereafter, both models agreed closely with respect to their estimates of asymptotic live-weight body burden of the radioisotope. The Richards model can describe quantitatively contaminant accumula-tion in those cases that cannot be adequately detion in those cases that cannot be adequately de-scribed by the classic equations. Although the Richards model can adequately describe accumula-tion data in an empirical sense, it does not provide information concerning the mechanisms responsi-ble for the particular accumulation pattern ob-served, as would be the case with a more determi-nistic model. Regardless of the mechanisms respon-sible for sigmoidal patterns of contaminant accu-mulation, the empirical demonstration and quantifi-cation of such phenomena may have great practi-cal importance in toxicological risk assessment and the environmental decision-making processes. (Authe environmental decision-making processes. (Author's abstract) W90-06773

RATE-LIMITING BARRIERS TO XENOBIO-TIC UPTAKE BY THE GILL. Washington State Univ., Pullman. Coll. of Phar-

W. L. Hayton, and M. G. Barron. Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 2, p 151-157, 1990. 3 fig. 1 tab, 28 ref. National Institutes of Health Grant ES01995. U.S. EPA Grant R812818.

Descriptors: *Adsorption, *Bioaccumulation, *Fish, *Gills, *Path of pollutants, *Pollutants, Biochemistry, Fish physiology, Model studies, Molecular structure, Theoretical analysis.

Waterborne xenobiotics enter fish and other aquatic species primarily by transfer across the gill epithelium. Potential barriers to uptake include epithelium. Potential barriers to uptake include water flow across the gill, diffusion across the gill epithelium and the overlying aqueous stagnant layer and blood flow through the gill (cardiac output). In general, for any particular chemical, only one of the barriers is operative with the resistance offered by the others being negligible. resistance offered by the others being negligible. The rate-limiting barrier is determined by the physical and biochemical properties of the substance: molecular size, lipophilicity, binding to blood proteins and formed elements. The resistance of each barrier is affected differently by variaance of each barrier is affected differently by variables such as temperature, molecular size, lipophilicity and body size of the animal. When the resistance offered by the gill barriers is low, uptake may be controlled by transfer to storage tissues, e.g., by blood flow to adipose tissue. (Author's abstract) W90-06774

SIMPLE FLOW-LIMITED MODEL FOR EX-CHANGE OF ORGANIC CHEMICALS AT FISH GILLS.

Environmental Research Lab., Duluth, MN.
R. J. Erickson, and J. M. McKim.
Environmental Toxicology and Chemistry
ETOCDK, Vol. 9, No. 2, p 159-165, 1990. 2 fig. 25

Descriptors: *Bioaccumulation, *Gills, *Mathematical models, *Model studies, *Organic compounds, *Path of pollutants, *Trout, Adsorption, Blood, Fish physiology, Kinetics, Toxicity.

A mathematical model for the exchange of organic chemicals by fish gills was formulated based solely on the limitations imposed by flows of water and blood into the gills. For large rainbow trout, this model was found to closely follow the magnitude and trends of observed gill uptake rates over a range of octanol/water partition coefficient from 1 to 1,000,000. Observations averaged only about 30% less than model predictions. This modest lack-of-fit is presumably due to the effects of diffusional partiers and ionization which would further limit of-fit is presumably due to the effects of diffusional barriers and ionization which would further limit uptake, although uncertainties in model parameters and data are likely also to be partly responsible. This analysis suggests that these basic physiological parameters are of major importance in the regulation of exchange at fish gills and should be accounted for in more detailed toxicokinetic models. This model could by itself be useful for approximate assessments of accumulation of organapproximate assessments of accumulation of organic chemicals by fish. (Author's abstract)

TOXICOKINETICS OF PAHS IN HEXAGENIA. National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

G. R. Stehly, P. F. Landrum, M. G. Henry, and C.

Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 2, p 167-174, 1990. 2 fig, 3 tab, 22 ref.

Descriptors: *Bioaccumulation, *Mayflies, *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Toxicity, *Toxicology, Benzopyrene, Biological magnification, Kinetics, Model studies, Phenanthrene.

The accumulation kinetics of two waterborne polycyclic aromatic hydrocarbons (PAHs),

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benzo(a)pyrene (BAP) and phenanthrene (PHE), were studied in the mayfly nymph (Hexagenia limbata). The uptake clearance decreased while the bioconcentration of BAP increased with an increase in weight of the H. limbata nymph. The relationship between uptake clearance and bioconcentration for PHE was variable, and bioconcentration. centration for PHE was variable, and bioconcen-tration was greater for the heavier animals. Two kinetic models were used to evaluate the effect of nymph weight on disposition of PAHs: (1) the amount-uptake clearance model (AUPCM), similar to models most frequently used in environmental toxicology; and (2) a clearance-volume model (CLVM), similar to models used in clinical pharnacology. The two models gave similar predictive results but were different in a few cases. These differences in common parameter estimation, probably resulted from methodologies used and high data variability rather than the models themselves, data variability rather than the models themselves, since they are mathematically equal. Some of the parameters are unique to each of the models; concentration of compound in the organism for AUPCM is the amount of compound per weight of animal, which is considered a weight-normalized amount per apparent volume of distribution in the CLVM. The clearance of oxygen from water is inversely and linearly related to the weight of the mayfly nymphs, but oxygen clearances were always much less than the uptake clearances of the PAHs. The high PAH uptake clearance compared to oxygen clearances implies a greater surface area or efficiency for PAH accumulation from water. (Author's abstract)

BIOACCUMULATION AND BIOTRANSFORMATION OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZO-FURANS

Utrecht Rijksuniversiteit (Netherlands). Environ-

Utreent Rijasumversace (Archermann)
mental Toxicology Section.
A. Opperhuizen, and D. T. H. M. Sijm.
Environmental Toxicology and Chemistry
ETOCDK, Vol. 9, No. 2, p 175-186, 1990. 5 fig, 1

Descriptors: *Bioaccumulation, *Biotransforma-tion, *Dibenzofurans, *Dioxins, *Fate of pollut-ants, *Fish, *Path of pollutants, Aromatic com-pounds, Biochemistry, Biological magnification, Excretion, Kinetics.

In spite of their hydrophobicity, not all polychlorinated dibenzo-p-dioxin (PCDD) and dibenzofuran (PCDF) congeners accumulate significantly in fish or other aquatic organisms. This is found both in laboratory experiments and in organisms that are sampled in the natural environment. Previous studies could not adequately predict or explain this congener-specific accumulation. Many PCDDs and PCDFs with four or more chlorine atoms, such as octachlorodibenzo-p-dioxin, are taken up very slowly, if at all, during aqueous exposure. Furthermore, the uptake rates after dietary exposure to these congeners are significantly less than Furthermore, the uptake rates after dietary expo-sure to these congeners are significantly less than those of other chlorinated aromatic hydrocarbons with comparable hydrophobicity, such as poly-chlorinated benzenes and biphenyls. A lack or a low rate of membrane permeation may help to explain this phenomenon. For several higher chlor-inated congeners, and for most of the lower chlor-inated dioxins and furans, the rates of uptake after distance and manous arrowers are comparable to mated congeners, and for most of the lower chloriated dioxins and furans, the rates of uptake after dietary and aqueous exposure are comparable to those of other hydrophobic aromatic hydrocarbons. The relatively low bioconcentration and biomagnification factors of these lower chlorinated PCDDs and PCDPs should, therefore, be explained by high rates of excretion, probably by biotransformation. In several studies, polar metabolites have been identified, and, in fish in which the cytochrome P-450 system was inhibited with piperonyl butoxide, the bioconcentration factor of 2,8-dichlorodibenzo-p-dioxin was significantly higher than that in fish which were not pretreated with the blocking agent. These results support the hypothesis that biotransformation is of paramount importance for the bioaccumulation of several PCDDs and PCDFs. (Author's abstract)

ACID NEUTRALIZATION IN LABORATORY SEDIMENT-WATER MICROCOSMS FROM A

ROCKY MOUNTAIN SUBALPINE LAKE (USA). Idaho National Engineering Lab., Idaho Falls. Center for Environmental Monitoring and Assess-

ment.
D. A. Bruns, T. P. O'Rourke, and G. B. Wiersma.
Environmental Toxicology and Chemistry
ETOCDK, Vol. 9, No. 2, p 197-203, 1990. 3 fig, 3
tab, 21 ref. DOE Contract DE-AC07-761D01570.

Descriptors: *Acid rain, *Denitrification, *Fate of pollutants, *Lake sediments, *Neutralization, *Nitric acid, *Sediment-water interfaces, *Sulfuric acid, Acidic water, Hydrogen ion concentration, Ion exchange

A laboratory sediment-water microcosm experiment for a Rocky Mountain subalpine lake was conducted over a 35-day incubation period. Three sets of treatments were acidified to a pH of 4.3 and compared with a set of control microcosms. Treatments included additions of nitric acid, sulfuric acid and both acids combined. All treatment microcosms demonstrated rapid pH recovery to near that of the controls (e.g., 6.2) and changes in ion concentration suggested that over 80% of this recovery could be accounted for by cation exchange and microbial reduction of sulfates and nitrates. Denitrification appeared to predominate in both sets of treatments that involved nitric acid while Dentifrication appeared to predominate in both sets of treatments that involved nitric acid while cation exchange (mostly calcium) was more important in the sulfuric acid treatment. pH recovery was most rapid in the nitric acid treatments, intermediate in the treatment with both acids and slowest in the sulfuric acid treatment. These results are consistent with published findings for both laboratory and field studies and demonstrate the potential importance of sediments for acid neutralization in a Rocky Mountain lake. (Author's abstract) W90-0678

5-METHYL DEOXYCYTIDINE CONTENT OF DNA FROM BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS) EXPOSED TO

BENZO(A)PYRENE.
Oak Ridge National Lab., TN. Environmental Sci-

Oak Ridge National Lab., 1 N. Environmental Sciences Div.
L. R. Shugart.
Environmental Toxicology and Chemistry
ETOCDK, Vol. 9, No. 2, p 205-208, 1990. 2 tab, 15
ref. Oak Ridge National Laboratory Contract DEAC05-840R21400.

Descriptors: *Benz(a)pyrene, *Bioaccumulation, *Bluegills, *DNA, *Path of pollutants, Carcino-gens, Ecological effects, Sunfish, Water pollution effects.

The 5-methyl deoxycytidine (m5-dCyd) content of DNA from bluegill sunfish chronically exposed to benzo(a)pyrene at a concentration of 1 microgram/L in their water for a period of 40 days was quantified by cation exchange chromatography. Hypomethylation, as measured by the loss of m5-dCyd from the DNA, occurred shortly after benzo(a)pyrene (BaP) exposure and continued even upon termination of exposure conditions. The onset and persistence of hypomethylation was found to be correlated with other types of DNA-damaging events such as strand breaks and DNA adduct formation. These observations suggest that changes in DNA integrity, including hypomethylation, are indicative of a biological response to genotoxic agents. (Author's abstract) genotoxic agents. (Author's abstract) W90-06779

DETERMINATION OF THE VENTILATION RATES OF INTERSTITIAL AND OVERLYING WATER BY THE CLAM MACOMA NASUTA. Environmental Research Lab-Narragansett, Newport, OR. Mark O. Hatfield Marine Science Center.

Center. M. H. Winsor, B. L. Boese, H. Lee, R. C. Randall, and D. T. Specht.
Environmental Toxicology and Chemistry
ETOCDK, Vol. 9, No. 2, p 209-213, 1990. 2 fig, 1 tab, 11 ref. EPA Contract CR813091.

Descriptors: *Adsorption, *Clams, *Interstitial water, *Path of pollutants, Chlorinated aromatic compounds, Dyes, Gills, Sediment-water inter-

The ventilation rates of interstitial and overlying The ventilation rates of interstitial and overlying water for the deposit-feeding, tellinid clam Macoma nasuta (Conrad) were determined using two water-soluble dyes to differentiate between the two water sources. A unique exposure chamber, the clambox, was used to separate the inhalant and exhalant siphons of the clam, allowing measurements of dye fluxes and total water ventilated. The results suggested that interstitial water constituted very little (4%) of the total amount of water ventilated by this clam. The accuracy of estimates of lated by this clam. The accuracy of estimates of interstitial water ventilation rate is dependent on the validity of assumptions used to convert the dye fluxes to water fluxes. Although interstitial water constitutes a minor amount of the water ventilated by M. nasuta, the extent of exposure to ventilated by M. nasuta, the extent of exposure to ventilated interstitial water will vary among infaunal organisms. In organisms with parchment-type tubes (e.g., Mesochaetopterus spp.), little interstitial water should pass through the tube and nearly all the ventilated water should be overlying water. In organisms with porous tubes or burrows made of loosely consolidated sediment (e.g., Callianassa californiensis), a greater portion of the ventilated water may be interstitial water pulled through the tube or burrow wall. (Author's abstract) W90-06780

METHOD FOR DETERMINING GUT UPTAKE EFFICIENCIES OF HYDROPHOBIC POLLUT-ANTS IN A DEPOSIT-FEEDING CLAM.

Environmental Research Lab. Narragansett, New-port, OR. Mark O. Hatfield Marine Science Center.

H. Lee, B. L. Boese, R. C. Randall, and J.

Environmental Toxicology and Chemistry ETOCDK, Vol. 9, No. 2, p 215-219, 1990. 2 tab, 21 ref. EPA Contract CR813091.

Descriptors: *Adsorption, *Chlorinated aromatic compounds, *Clams, *Fate of pollutants, *Path of pollutants, Interstitial water, Marine sediments, Orzanic carbon, Sorption.

Deposit-feeding invertebrates select particles for ingestion that are richer in organic carbon, and ingestion that are richer in organic carbon, and thus higher in pollutant concentration, then the mean values of bedded sediment. To estimate the ingested pollutant dose, a method was developed that uses the enrichment of the total organic carbon concentration (TOC) of the feces compared to the TOC of the bedded sediment as a measure of pollutant enrichment in the ingested particles. The deposit-feeding clam Macoma nasuta (Conrad) was exposed for 7 days in clamboxes to either bulk or fine sediment fractions that varied in TOC Feces responsed for values in calmosas to entire with of fine sediment fractions that varied in TOC. Feces were collected and the TOC of sediment and feces estimated. The TOC of the feces was corrected for the carbon lost during digestion. The selectivity index (SI), the ratio between the corrected TOC of index (SI), the ratio between the corrected TOC of the feces and TOC of the bedded sediment, was determined to be 4.36 and 1.72 for the bulk and fine sediment fractions. The SI was then applied to data from a companion study in which M. nasuta was exposed to hexachlorobenzene (HCB) dosed sediment. The efficiency of gut uptake of HCB sorbed on ingested sediment ranged from 38 to 56%, with the lower value the more reliable. The effects of selection by deposit feeders for organically rich, high pollutant particles needs to be considered in experiments measuring the bioavailability of sediment-sorbet pollutants or in experibility of sediment-sorbet pollutants or in experibility of sediment-sorbet pollutants or in experibility of sediment-sorbet pollutants or in experiments considered in experiments measuring the notavatia-bility of sediment-sorbed pollutants or in experi-ments attempting to determine the routes of pollut-ant uptake. (Author's abstract) W90-06781

COMPARISON OF AQUEOUS AND SOLID-PHASE UPTAKE FOR HEXACHLOROBEN-ZENE IN THE TELLINID CLAM MACOMA NASUTA (CONRAD): A MASS BALANCE AP-PROACH.

Environmental Research Lab.-Narragansett, New-port, OR. Mark O. Hatfield Marine Science Center.

B. L. Boese, H. Lee, D. T. Specht, R. C. Randali,

and M. H. Winsor.

Environmental Toxicology and Chemistry

ETOCDK, Vol. 9, No. 2, p 221-231, 1990. 1 fig, 4
tab, 33 ref. EPA Contract CR813091.

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Descriptors: *Bioaccumulation, *Chlorinated aromatic compounds, *Clams, *Fate of pollutants, *Marine sediments, *Path of pollutants, Adsorption, Gills, Interstitial water, Model studies, Sediment contamination, Suspended solids, Tissue analysis

The uptake of sediment-associated hexachloroben-The uptake of sediment-associated hexachloroben-zene (HCB) by the deposit-feeding clam Macoma nasuta (Conrad) was determined using a clam ven-tilation chamber. Clams were exposed to Cl4-HCB-dosed sediment, and the Cl4 amounts were measured in inhalant and exhalant waters, fecal pellets and soft issues. The volume of water the clam ventilated and the amount of fecal pellets produced were measured. The contributions of 10 possible uptake routes to HCB tissue residues were estimated using a bioenergetic-based bioaccumulation model. Mass balance results indicate that uptake of HCB by the gut from ingested solids wa uptake of HCB of the gut from ingested soulds was the single most important route, accounting for 63 to 84% of HCB tissue residues. The next largest route was uptake from interstitial water ventilated across the gills, which accounted for 11 to 12% of tissue residues. Uptake of HCB from overlying tissue residues. Uptake of HCB from overlying water was minimal. These results indicate that sediment-bound HCB is bioavailable to benthic deposit feeders such as Macoma and supports the contention that ingested sediment is an important uptake route for highly lipophilic pollutants. (Au-

MERCURY BINDING PROTEINS IN LIVER AND MUSCLE OF FLAT FISH FROM THE NORTHERN TYRRHENIAN SEA.

NORTHERN 1 TRRHENTAN S.A. Istituto di Biofisica, Pisa (Italy). C. Barghigiani, D. Pellegrini, and E. Carpene. Comparative Biochemistry and Physiology (C) CBPCEE, Vol. 94, No. 1, p 309-312, 1989. 2 fig. 1 tab. 29 ref.

Descriptors: *Bioaccumulation, *Fish physiology, *Italy, *Mercury, *Path of pollutants, *Tyrrhenian Sea, Flat fish, Liver, Muscle, Tissues.

The subcellular distribution of mercury and possible presence of Hg binding proteins of low molec-ular weight were investigated by ultracentrifuga-tion and gel filtration in liver and muscle of the flat fish Citharus linguatula and Lepidorhombus boscii fish Citharus linguatula and Lepidorhombus boscii from the northern tyrrhenian sea, heavily contaminated by the metal. For both tissues, Hg contents were higher in the pellet than in the supernatant. In the eluate of supernatant from Sephadex G-75 of both tissues, Hg was mainly bound to high molecular weight ligands. In contrast with the muscle eluate, that from liver also contained a consistent amount of Hg bound to low molecular weight ligands. (Author's abstract) W90-06784

PHOTOCHEMICAL TRANSFORMATION IN AQUEOUS SOLUTION AND POSSIBLE ENVI-RONMENTAL FATE OF ETHYLENEDIAMIN-ETETRAACETIC ACID (EDTA).

Hohenheim Univ., Stuttgart (Germany, F.R.). Inst.

R. Frank, and H. Rau.

Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 55-63, February 1990. 5 fig, 2 tab, 27 ref.

Descriptors: *EDTA, *Fate of pollutants, *Industrial wastes, *Path of pollutants, *Wastewater pollution, Degradation, Iron complexes, Photochemi-

Ethylenediaminetetraacetic acid (EDTA) is used in Ethylenediaminetetraacetic acid (EDTA) is used in a large variety of products, e.g., laundry detergents, cosmetics, photochemicals, and pharmaceuticals, and in industries, e.g., textiles and galvanic and paper manufacturing. The content of EDTA in laundry detergents varies between 0.1 and 0.5%. When EDTA is released with wastewater streams, removal will not occur in the wastewater treatment plants. In natural waters, EDTA in the form of its differently protonated Fe(III) complexes can be transformed by photochemical reactions. In central Europe, these reactions can be relatively effective in summer but during winter most of the

EDTA will reach the sea. Other abiotic processes are not likely to contribute to the degradation of EDTA. (Author's abstract)

ESTIMATION OF RELEASES INTO RIVERS WITH THE STEADY-STATE SURFACE WATER MODEL EXWAT USING DICHLORO-METHANE.

llschaft fuer Strahlen- und Umweltforsch m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungsponteniale Projektgruppe von Chemikalien.

von Chemikaine, S. Trapp, R. Bruggemann, and B. Munzer. Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 72-80, February 1990. 4 fig. 2 tab, 14 ref.

Descriptors: *Dichloromethane, *Fate of pollut-ants, *Hazardous wastes, *Model studies, *Moni-toring, *Path of pollutants, Rhine River.

The surface water model EXWAT is applied to nne surface water mouel EAWA! is applied to monitoring studies of hazardous substances to esti-mate site-specific emissions from measured concen-trations. The model includes the main processes which govern the fate of chemicals in rivers, which govern the fate of chemicals in rivers, namely, advection, volatility, degradation process, sedimentation, resuspension, and protonic equilibria. The steady-state solution of the linear mass balance equations leads to proportionality between input and concentration of a chemical, which is used to assess input rates from measured concentrations. Subsequently, the model can be used for pollution control and identification of unknown releases. With measured concentrations in the Rhine near Koblenz (95 km downstream from the mouth of the river Main) the load of dichloromethane from the triputary Main was estimated. The ane from the tributary Main was estimated. The comparison with measured concentrations in the tributary mouth has a good agreement in this case. (Author's abstract) W90-06791

ALUMINUM ACCUMULATION IN A LOTIC MAYFLY AT LOW PH-A LABORATORY STUDY.
Lund Univ. (Sweden). Dept. of Animal Ecology.
K. G. Frick, and J. Herrmann.
Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 81-88, February 1990. 1 fig, 2 tab, 15 ref.

Descriptors: *Acid rain effects, *Aluminum, *Aquatic insects, *Bioaccumulation, *Bioassay, *Mayflies, *Path of pollutants, Life stages,

The occurrence of aluminum (Al) accumulation in The occurrence of aluminum (AI) accumulation in nymphs of the mayfly Heptagenia sulphurea at low pHI (4.5) was studied experimentally. Nymphs were exposed to two AI concentrations (0.2 and 2 mg inorganic AI/L), and two exposure times (2 and 4 weeks), the longer time period also including a molting phase. The major part of the AI was deposited on/in the exuviae of the nymphs, as AI determination in nymphs showed a 70% decrease in AI content after molting. When nymphs were exposed for two instan periods, with a molt in exposed for two instar periods, with a molt in between, Al content almost doubled (2.34 mg Al/g dry wt) compared with that of a one-instar treatment (1.24 mg Al/g dry wt). This indicated that Al also accumulated within the mayfly nymphs. Determination of Al in emerged adults confirmed that most of the metal was deposited externally on the nymphs. No clear indications of Al accumulation were found in this short-term experiment. The implications for food-web accumulation of Al are implications for tood-web accumulation of AI are that internally accumulated AI may be transferred to terrestrial predators by mayflies and other aquatic insects that leave their final exuvium in the water. However, aquatic insects that make their final molt in the terrestrial environment, and there-by bring adsorbed Al out of the water are more likely vectors. (Author's abstract)

PERFUSED FISH GILL PREPARATION IN STUDIES OF THE BIOAVAILABILITY OF CHEMICALS.

Uppsala Univ. (Sweden). Dept. of Zoophysiology. For primary bibliographic entry see Field 5A. W90-06795

AQUATIC SURFACE MICROLAYER CON-TAMINATION IN CHESAPEAKE BAY. Battelle Pacific Northwest Labs., Sequim, WA.
Marine Research Lab.

Marine Research Lab.
J. T. Hardy, E. A. Crecelius, L. D. Antrim, S. L. Kiesser, and V. L. Broadhurst.
Marine Chemistry MRCHBD, Vol. 28, No. 4, p 333-352, January 1990. 2 fig. 5 tab, 53 ref.

Descriptors: *Chesapeake Bay, *Estuaries, *Heavy metals, *Hydrocarbons, *Microlayer contamination, *Path of pollutants, *Pollutant identification, Coal combustion, Fuel, Oil pollution.

The aquatic surface microlayer (SMIC), approximately 50 microns thick, serves as a concentration point for metal and organic contaminants that have low water solubility or are associated with floatpoint for metal and organic contaminants that have low water solubility or are associated with floatable particles. Also, the eggs and larvae of many fish and shellfish species float on, or come in contact with, the water surface throughout their early development. The objectives of this study were: (1) to determine the present degree of aquatics surface microlayer pollution at selected sites in Chesapeake Bay; and (2) to provide a preliminary evaluation of sources contributing to any observed contamination. Twelve stations located in urban bays, major rivers, and the north central bay were sampled three times, each at approximately 5-day intervals during May 1986. Samples of 1.4-4 L each were collected from the upper 30-60-microns water surface (surface microlayer, SMIC) using a Teffon-coated rotating drum microlayer sampler. At all stations, concentrations of metals, alkanes, and aromatic hydrocarbons in the SMIC were compared with one bulk-water sample and with typical concentrations in water of Chesapeake Bay and elsewhere. SMIC contamination varied greatly among the three sampling times, but high mean contexticits level (educations) are surface to the contamination are contexticed. and elsewhere. SML contamination varied greatly among the three sampling times, but high mean contaminant levels (total polycyclic aromatic hydrocarbons, 1.9-6.2 micrograms/L; Pb, 4.9-24 micrograms/L; Cu, 4-16 micrograms/L; and Zn, 34-59 micrograms/L) were found at the upper Potograms or the proper polycyclic aromatic aroses and northern have sites. Three separate aroses mac and northern bay sites. Three separate areas were identified on the basis of relative concentrations of different aromatic hydrocarbons in SMIC samples—the northern bay, the Potomac River, and the cleaner southern and eastern portions of the sampling area. Suspected sources of surface contamination include gasoline and diesel fuel combus-tion, coal combustion, and petroleum product re-leases. Concentrations of metals and hydrocarbons, acases. Concentrations of metals and hydrocarbons, at approximately half the stations sampled, are sufficient to pose a threat to the reproductive stages of some fish and shellfish. (Author's abstract) W90-06803

CHEMICAL PROPERTIES OF A LOW-OXYGEN WATER COLUMN IN PORT HACK-ING (AUSTRALIA): ARSENIC, IODINE AND

Melbourne Univ., Parkville (Australia). Marine Chemistry Lab. For primary bibliographic entry see Field 2K. W90-06804

PROBLEMS AND METHODS INVOLVED IN RELATING LAND USE TO GROUND-WATER

Geological Survey, Trenton, NJ. T. Barringer, D. Dunn, W. Battaglin, and E. Vowinkel.

Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 1-9, February 1990. 5 fig, 4 tab, 12 ref.

Descriptors: *Data interpretation, *Groundwater quality, *Land use, *Nonpoint pollution sources, *Statistical methods, *Water pollution sources, Data closure, Data requirements, Misclassification, Shallow aquifers, Skewing, Spatial autocorrelation.

Efforts to relate shallow groundwater quality to the land use near a well lead to several statistical difficulties. These include potential uncertainty in

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land-use categorical data due to misclassification, data closure, distributional skewing, and spatial autocorrelation. Methods of addressing these problems are, respectively, the establishment of limits on minimum buffer radius, the estimation of contrasts, rank-based tests of association, and sub-sampling to prevent buffer overlap. Relations between the presence of purgeable organic compounds in ground water and land use are used to illustrate these problems and methods. (Author's abstract) W90-06817

ORGANOCHLORINE PESTICIDE RESIDUES IN BED SEDIMENTS OF THE SAN JOAQUIN RIVER, CALIFORNIA.

Geological Survey, Sacramento, CA. R. J. Gillion, and D. G. Clifton. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 11-24, February 1990. 4 fig, 6 tab, 31 ref.

Descriptors: *California, *DDD, *DDE, *DDT, *Dieldrin, *Pesticides, *San Joaquin River, *Sediment contamination, Areal distribution, Correlation analysis, Fate of pollutants, Suspended sediments. Tributaries.

Bed sediments of the San Joaquin River and its tributaries were sampled during October 7-11, 1985, and analyzed for organochlorine pesticide residues in order to determine their areal distribution and to evaluate and prioritize needs for further study. Residues of DDD, DDE, DDT, and dieldrin are widespread in the fine-grained bed sediments of the San Joaquin River and its tributaries despite little or no use of these pesticides for more than 15 years. The San Joaquin River has among the highest bed-sediment concentrations of DDD, DDE, DDT, and dieldrin residues of major rivers in the United States. Concentrations of all four pesticides were correlated with each other and with the amount of organic carbon and fine grained particles in the bed sediments. The highest concentrations occurred in bed sediments of west-side tributary streams. Potential tributary loads of DDD, DDE, DDT, and dieldrin to the San Joaquin River were computed from bed-sediment concentrations and data on streamflow and suspended-sediment concentration in order to identify the general magnitude of differences between streams and to determine study priorities. The estimated loads indicate that the most important sources of residues during the study period were Salt Slough because of a high load of fine seediment, and Newman Wasteway, Orestimba Creek, and Hospital Creek because of high bed-sediment concentrations. Generally the highest estimated loads of DDD, DDE, DDT, and dieldrin were in Orestimba and Hospital Creeks. (Author's abstract) W90-06818

NUTRIENT DISTRIBUTION AND VARIABILITY IN THE CHARLOTTE HARBOR ESTUARINE SYSTEM, FLORIDA.

RINE SYSTEM, FLORIDA. Geological Survey, Tampa, FL. B. F. McPherson, and R. L. Miller. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 67-80, February 1990. 11 fig, 4 tab, 36 ref.

Descriptors: *Eutrophication, *Florida, *Nitrogen, *Nutrients, *Phosphorus, *Phytoplankton, *Silica, *Urbanization, Ammonia, Dilution curves, Distribution patterns, Light, Limiting nutrients, Model studies, Nitrates, Nitrites.

The sources and distribution of nutrients in the Charlotte Harbor (Florida) estuarine system were evaluated using nutrient dilution curve models. Except for ammonia, nutrient concentrations were highest and most variable in the rivers, and generally decreased with increasing salinity. Observed and theoretical dilution curves for phosphorus were generally in close agreement, which suggests conservative behavior. Phosphorus concentrations sagged below a straight line because phosphorusrich water from the upper Peace River basin was diluted by tributaries in the lower basin. The concentrations of dissolved silica appeared to be conservative on some occasions. On other occasions, dissolved silica appeared to be removed at low salinities or released at higher salinities. Concentrations of ammonia were highly variable along the

salinity gradient, presumably because of variations in ammonia regeneration and uptake. Concentrations of nitrite plus nitrate were well below conservative dilution curves, probably due to phytoplankton uptake. At salinities greater than 20 ppt nitrite plus nitrate concentrations were usually at or below the detection limit and may limit phytoplankton productivity. Projected increased nitrogen loadings from urban development in the basin would favor undesirable increases in phytoplankton and benthic algal growth in waters where sufficient light is available. (Author's abstract) W90-06824

KINETICS OF CHLORINATED HYDROCAR-BON DEGRADATION BY SUSPENDED CUL-TURES OF METHANE-OXIDIZING BACTE-

Washington Univ., Seattle. Coll. of Forest Resources.
For primary bibliographic entry see Field 5G. W90-06835

ADVECTIVE-DISPERSIVE TRANSPORT OF DENSE ORGANIC VAPORS IN THE UNSATU-RATED ZONE. 1. MODEL DEVELOPMENT. Waterloo Univ. (Ontario). Inst. for Ground Water Research.

Research.
C. A. Mendoza, and E. O. Frind.
Water Resources Research WRERAQ, Vol. 26,
No. 3, p 379-387, March 1990. 5 fig, 3 tab, 26 ref.

Descriptors: *Advection, *Aeration zone, *Chlorinated hydrocarbons, *Dispersion, *Mathematical models, *Model studies, *Path of pollutants, *Soil water, *Soilute transport, *Unsaturated flow, Groundwater, Trichloroethane.

Vapors from organic liquids that are suspended as residual in the unsaturated zone can migrate considerable distances through the aerated pore space and thus cause extensive contamination of the groundwater. In order to investigate the various transport mechanisms that play a role in the migration of these vapors, a numerical model was developed. The model includes and distinguishes between the processes of diffusion, advection due to density gradients, and advection due to the vapor mass released by vaporization at the source. Phase partitioning to the soil moisture is represented as an equilibrium retardation process that both slows plume development and makes contaminants available for transport by infiltrating water. The formulation is analogous to that for density-dependent transport in the saturated zone. Asisymmetric coordinates are used in order to represent localized residual-saturation solvent sources. Application to a three-dimensional laboratory experiment showed that inclusion of density-driven advection provides a better match with the observations. A simulation of the migration of 1,1,1-trichloroethane vapors in a highly permeable coarse sand demonstrated that advection may be a very effective transport mechanism. (See also W90-06848) (Author's abstract) W90-06847

ADVECTIVE-DISPERSIVE TRANSPORT OF DENSE ORGANIC VAPORS IN THE UNSATURATED ZONE. 2. SENSITIVITY ANALYSIS. Waterloo Univ. (Ontario). Inst. for Ground Water Research.

Research. C. A. Mendoza, and E. O. Frind. Water Resources Research WRERAQ, Vol. 26, No. 3, p 388-398, March 1990. 13 fig, 3 tab, 11 ref.

Descriptors: *Advection, *Aeration zone, *Dispersion, *Mathematical models, *Model studies, *Path of pollutants, *Soil water, *Solute transport, *Unsaturated flow, Groundwater.

In the migration of dense organic vapors in the unsaturated zone, advection due to density gradients can play an important or even dominant role under certain conditions. Advective transport can distribute contaminants over a wide area within the unsaturated zone, thus increasing the potential for groundwater contamination. The controls on gas phase advective-dispersive transport from a residual source of a generic organic compound were investigated using a numerical model. A sensitivity

analysis revealed that, for compounds with high vapor pressures and molecular weights, in high permeability environments (coarse sands or gravels), the mass transported by density-dependent advection may greatly exceed that transported by diffusion alone. If density-dependent advection is the dominant transport mechanism, the extent of the contaminated area is increased if the ground surface is open to the atmosphere, rather than covered. The opposite is true for a diffusion-controlled system. For either case an open ground surface contributes to a more rapid depletion of the residual liquid source. The advective mass flux caused by the release of vapor due to vaporization at the source is seen to be of minor importance. (See also W90-06847) (Author's abstract)

EXACT INTEGRAL SOLUTIONS FOR TWO-PHASE FLOW.

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
D. B. McWhorter, and D. K. Sunada.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 399-413, March 1990. 15 fig. 1 tab, 32 ref. Colorado Agricultural Experiment Station Project 1-53491.

Descriptors: *Flow equations, *Multiphase flow, *Path of pollutants, *Soil water, *Unsaturated flow, Groundwater movement.

Exact integral solutions for the horizontal, unsteady flow of two viscous, incompressible fluids are derived. Both one-dimensional and radial displacements are calculated with full consideration of capillary drive and for arbitrary capillary-hydraulic properties. One-dimensional, unidirectional displacement of a nonwetting phase is shown to occur increasingly like a shock front as the poresize distribution becomes wider. This is in contrast to the situation when an inviscid nonwetting phase is displaced. The penetration of a nonwetting phase into porous media otherwise saturated by a wetting phase occurs in narrow, elongate distributions. Such distributions result in rapid and extensive penetration by the nonwetting phase. The process is remarkably sensitive to capillary-hydraulic properties at large wetting phase saturations, a region in which laboratory measurements provide the least resolution. The penetration of a nonwetting phase can be expected to be dramatically affected by the presence of fissures, worm holes, or other macropores. Calculations for radial displacement of a nonwetting phase resident at a small initial saturation show the displacement to be inefficient. The fractional flow of the nonwetting phase falls rapidly and, for a specific example, becomes 1 ppt by the time one pore volume of water has been injected. (Author's abstract)

ANALYSIS OF ONE-DIMENSIONAL SOLUTE TRANSPORT THROUGH POROUS MEDIA WITH SPATIALLY VARIABLE RETARDA-TION FACTOR.

Stanford Univ., CA. Dept. of Civil Engineering. C. V. Chrysikopoulos, P. K. Kitanidis, and P. V.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 437-446, March 1990. 5 fig, 43 ref. EPA Grant No. 815738.

Descriptors: *Advection, *Dispersion, *Ground-water movement, *Model studies, *Path of pollutants, *Solute transport, Mathematical models.

A closed-form analytical small-perturbation (or first-order) solution to the one-dimensional advection-dispersion equation with spatially variable retardation factor was derived to investigate the transport of sorbing but otherwise noareacting solutes in hydraulically homogeneous but geochemically heterogeneous porous formations. The solution was developed for a third-, or flux-type inlet boundary condition, which is applicable when considering resident (volume-averaged) solute concentrations, and a semi-infinite porous medium. For mathematical simplicity is was hypothesized that the sorption processes are based on linear equilibria

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um isotherms and that the local chemical equilibrium isonerms and that the local chemical equinorum assumption is valid. The results from several simulations, compared with predictions based on the classical advection-dispersion equation with constant coefficients, indicated that at early times, spatially variable retardation affects the transport behavior of sorbing solutes. The zeroth moments corresponding to constant and variable retardation are not necessarily equal. The impact of spatially variable retardation increases with increasing Peclet number. The center of mass appears to move more slowly, and solute spreading is en-hanced in the variable retardation case. At late times, when the travel distance is much larger than the correlation scale of the retardation factor, the zeroth moment for the variable retardation case zeroth moment for the variable retardation case
was identical to the case of invariant retardation.
The small-perturbation solution agreed closely
with a finite difference numerical approximation.
(Author's abstract)
W90-06852

EFFECTS OF PARAMETER UNCERTAINTY ON LONG-TERM SIMULATIONS OF LAKE ALKALINITY.

Iowa Univ., Iowa City. Dept. of Civil and Envi-

romental Engineering.
S. Lee, K. P. Georgakakos, and J. L. Schnoor.
Water Resources Research WRERAQ, Vol. 26,
No. 3, p 459-467, March 1990. 7 fig, 6 tab, 17 ref.

Descriptors: *Acid rain effects, *Alkalinity, *Error analysis, *Hydrologic models, Adirondack Park, *Lakes, *Model studies, *New York, *Water chemistry, Lake Panther, Lake Woods.

A first-order second-moment uncertainty analysis A hist-order second-induction timetramity analysis has been applied to two lakes in the Adirondack Park, New York, to assess the long-term response of lakes to acid deposition. Uncertainty due to parameter error and initial condition error was considered. Because the enhanced trickle-down (ETD) model is calibrated with only 3 years of field data and is used to simulate a 50-year period, the uncertainty in the lake alkalinity prediction is relatively large. When a best estimate of parameter uncertainty is used, the annual average alkalinity is predicted to be -39 to +17 microeq/L for Lake Woods and 3 to 281 microeq/L for Lake Panther atter 50 years. Hydrologic parameters and chemical weathering rate constants contributed most to the uncertainty of the simulations. Results indicate that the uncertainty in long-range predictions of lake alkalinity increased significantly over a 5 to 10-year period and then reached a steady state. (Author's abstract)

MODELING TRANSIENT STORAGE AND NI-TRATE UPTAKE KINETICS IN A FLUME CONTAINING A NATURAL PERIPHYTON COMMUNITY.

California Univ., Davis. Dept. of Chemical Engi-

neering.
B. K. Kim, A. P. Jackman, and F. J. Triska.
Water Resources Research WRERAQ, Vol. 26, No. 3, p 505-515, March 1990. 6 fig, 4 tab, 40 ref.

Descriptors: *Artificial watercourses, *Biodegradation, *Cycling nutrients, *Flumes, *Hydraulics, *Model studies, *Nitrates, *Nutrient transport, *Nutrients, Fate of pollutants, Kinetics.

An existing transport model including storage zones was combined with a submodel describing biotic retention of nutrient based on Michaelis-Menten kinetics. This transport/retention model was used to simulate the results of an experiment in which the inflows to flumes containing nitrate-limited natural stream periphyton on artificial sub-strates were amended with chloride and nitrate. Hydrodynamic parameters were determined by fit-ting the model to the chloride data. The Michaelis-Menten maximum uptake rate parameter was de-termined by fitting the model to the nitrate data. The transport/retention model accurately simulated the responses of the flumes to the amendments. Independent batch experiments to determine Mi-chaelis-Menten parameters were performed on per-iphyton from a control flume. The maximum uptake rate parameters from the two experiments

are in good agreement. Both experiments indicate are in good agreement. Sont experiments indicate possible inadequacies of the Michaelis-Menten kinetic model for describing nutrient uptake in a complex field community. (Author's abstract) W90-08660

DIFFUSION AND CONSUMPTION OF METH-ANE IN AN UNSATURATED ZONE IN NORTH-CENTRAL ILLINOIS, U.S.A.

NORTH-CENTRAL ILLANOIS, U.S.A. Geological Survey, Denver, CO. R. G. Striegl, and A. L. Ishii. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 133-143, November 1989. 1 fig, 4 tab, 33 ref.

Descriptors: *Aeration zone, *Illinois, *Methane, *Model studies, *Path of pollutants, *Radioactive wastes, *Soil gases, Mathematical models, Microorganisms, Numerical analysis, Simulation.

The distribution of CH4 in unsaturated glacial and eolian deposits adjacent to buried low-level radio-active waste was measured, and movement of the active waste was measured, and movement of the gas from the waste source was simulated using a two-dimensional finite-difference model for gas diffusion in the unsaturated zone. Mean PCH4 was greatest (1.56 Pa) in a pebbly-sand deposit 11.6 m below the land surface and 12 m from the waste, and generally decreased with increased horizontal distance from the waste. Mean PCH4 was at least (0.07 Pa) at a depth of 1.8 m below land surface, regardless of the distance from the waste. PCH4 at the land surface, averaged 0.17 Pa. Depth versus regardless of the distance from the waste. PCH4 at the land surface averaged 0.17 Pa. Depth versus PCH4 profiles suggest consumption of both waste-produced and atmospheric CH4 in the upper un-saturated zone, presumably by methanotrophic microorganisms. Numerical simulations of methane movement support the consumption observation; inclusion of a term in the model for consumption inclusion of a term in the model for consumption of CH4 in the upper 2 m of the unsaturated zone resulted in simulated PCH4 within 30% of mean PCH4 at 11/13 sample locations. A similar fit of data was obtained for only four locations where consumption was not considered. (Author's ab-W90-06890

ABIOTIC TRANSFORMATION OF HALOGE-NATED ORGANIC COMPOUNDS: II. CONSID-Florida International Univ., Miami. Drinking Water Research Center.

W. J. Cooper, R. A. Slifker, J. A. Joens, and O. A.

Bi-Shaziy.

IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 37-46, 2 fig, 3 tab, 28 ref. EPA Grant R-811473-01-0.

Descriptors: *Chemical degradation, *Chemical reactions, *Groundwater pollution, *Halogenated compounds, *Path of pollutants, *Water treatment, Chlorinated hydrocarbons, Degradation products, Fate of pollutants, Hydrogen ion concentration Lime, Pentachloroethane, Temperature, Tetrachloroethane, Water softening.

Many groundwater and surface water contami-nants reported are halogenated organic compounds, causing increasing concern about contami-nation of drinking water when these source waters are used. Another area of concern is the possibility of changes occurring in these compounds as a result of chemical reactions during water treatment. Two of the abiological reactions of haloge-nated ethanes, elimination and substitution, accelerated by the high pH encountered in the lime soft-ening process or in the water distribution system, were examined. The extent to which either reac-tion occurs depends upon the halogenated ethane and the reaction conditions. It appears that the compounds 1,1,1,2-tetrachloroethane, 1,1,2,2-tecompounds 1,1,2-tetrachloroethane, 1,1,2-tetrachloroethane and pentachloroethane may be affected during water treatment, but it is unknown to what extent and under what conditions these reactions occur. Tap water from two locations in Miami, Florida and water from two treatment plants were sampled after lime softening and prior to recarbonation. It was found that the normal processing of lime softening and water distribution at practice of lime softening and water distribution at pH 9 promotes a significant abiotic transformation of chlorinated ethanes. Elimination is the only important reaction pathway for 1,1,1,2-tetrachlor-

oethane, 1,1,2,2-tetrachloroethane and pentachloroethane at room temperature and neutral or basic pH. The elimination reactions in all cases are first pH. The elimination reactions in all cases are first order in halogenated ethane and first order in hydroxide ion. The disappearance of 1,1,1-trichloroethane is independent of pH over the limited range of pH examined. Heavy metals in solution do not affect the rate of the elimination reaction of 1,1,2,2-tertachloroethane at neutral pH. (See also W90-06906) (Fish-PTT)

TRANSFORMATION KINETICS OF 1,1,1-TRICHLOROETHANE TO THE STABLE PRODUCT 1,1-DICHLOROETHANE. STABLE

Florida Univ., Gainesville. P. V. Cline, and J. J. Delfino.

IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 47-56, 3 fig, 3 tab, 14 ref.

Descriptors: *Chemical analysis, *Chemical degradation, *Chemical reactions, *Degradation products, *Groundwater pollution, *Water pollution sources, Chlorinated hydrocarbons, Gas chromatography, Groundwater, Mass spectrometry, Seawater, Temperature effects.

The common occurrence of 1,1-dichloroethene (1,1-DCE) as a groundwater contaminant cannot be entirely explained by its production and usage patterns. One source of 1,1-DCE occurs during the abiotic degradation of 1,1,1-trichloroethane (TCA). Conflicting information about the rate and transformation processes of TCA makes extrapolation of rates to field sites or treatment processes difficult. The measurement of the overall rate of degradation of TCA and the proportion of prod-ucts formed, as well as the definition of parameters that influence these factors, were evaluated in a laboratory. Buffers and stock standard solutions were prepared. Seawater samples were obtained from the coastal Atlantic Ocean near Florida. Groundwater samples were collected from two monitoring wells located at a site in Florida which monitoring wells located at a site in Florida which had been contaminated by chlorinated solvents. Samples were analyzed using a purge and trap device interfaced with a GC (gas chromatograph) with flame ionization detector. Selected analyses were performed by GC/MS (mass spectroscopy) to confirm the formation of 1,1-DE. The abiotic degradation of TCA in water occurs relatively rapidly. The rate-determining step in the degradation of TCA showed minor increases as ionic strength increased from distilled deionized water to seawater matrices, supporting the hypothesis for to seawater matrices, supporting the hypothesis for the formation of an ionic intermediate. The transformation of TCA to 1,1-DCE and the stability of tormation of ICA to 1,10-E and the standing of the ethene under typical environmental conditions contribute to the frequency at which the elimination product is observed in water supplies. 1,1-DCE is frequently the dominant degradation product where TCA is present. The major factor affecting the rate of abiotic transformation appears to be temperature. (See also W90-06906) (Fish-PTT) W90-06910

PATHWAYS FOR THE PRODUCTION OF OR-GANOCHLORINE COMPOUNDS IN THE CHLORINATION OF HUMIC MATERIALS. Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.

IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 97-106, 5 fig. 3 tab, 20 ref.

Descriptors: *Chemical treatment, *Chlorinated Descriptors: "Chloria treatment, "Chloria hydrocarbons, "Chloriation, "Humic acids, "Oxidation, "Path of pollutants, "Water pollution sources, "Water treatment, Amino acids, Chemical precipitation, Chemical reactions, Chloroform, Filtration, Organic matter, Proteins, Resorcinol

It is generally accepted that the reaction between chlorine and aqueous humic material is responsible for the production of organochlorine compounds in the chlorination process of drinking water. An investigation was made into different pathways for the production of organochlorine compounds by

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using KMnO4 preoxidation of humic acid to de-stroy resorcinol precursor structures. A series of oxidations was performed by adding various amounts of KMnO4 solution to a mixture of humic acid standard solution and carbonate buffer. After a reaction time, the solutions were acidified. Any residual of KMnO4 was reduced, and the pH of the resulting solution was increased. the resulting solution was increased to precipitate the MnO2, which was removed by filtration. Carbonate was then removed and the pH adjusted. After analyzing for the total organic content, the Solutions were used for chlorination experiments.

The presence of resorcinol-type structures in humic material is uncertain because direct instrumental or chemical evidence for these structures is missing. KMn04 oxidation of the humic acids decreased the production of chloroform and trichloroethane. However, other precursor structures must be present for complete oxidation of resorcinol structures. Resorcinol structures in humic material may therefore explain part of the organochlorine production, but other precursor structures are also important. When the reactivity of proteins and amino acids under normal chlorination conditions can be demonstrated, they may explain several of the chlorination products that cannot be under-stood on the basis of resorcinol structures. (See also W90-06906) (Fish-PTT) W90-06914

SOME LIPOPHILIC COMPOUNDS FORMED IN THE CHLORINATION OF PULP LIGNIN AND HUMIC ACIDS.

Svenska Traeforskningsinstitutet, Stockholm Svenska Traerorskningsinsitutet, Stochards...
A. B. McKague, and K. P. Kringstad.
IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 123-131, 5 fig, 2 tab, 23 ref.

escriptors: *Bleaching wastes, *Chlorination, Humic acids, *Pulp wastes, *Chlornation, *Humic acids, *Pulp wastes, *Wastewater treatment, Chemical analysis, Drinking water, Environmental impact, Gas chromatography, Lipids, Mass spectrometry, Organic wastes, Pollutant identification, Pulp and paper industry, Synthesis, Toxic wastes, Toxicity.

A number of chlorinated lipophilic compounds have entered our environment and have been found to persist for many years and to accumulate in aquatic organisms and sediments. During the conventional bleaching of chemical pulps, organic material is dissolved in the bleaching liquors. Much of the dissolved material is chlorinated and organically bound chlorine is produced. It is known that bleaching liquors exert weak acute toxic and genotoxic effects, and several compounds that are responsible for such effects have been identified. A scheme was developed for concentration and idensical scheme. sponsible for such effects have been identified. A scheme was developed for concentration and identification of lipophilic compounds in spent bleach liquors. The liquor was first extracted with hexane. Lipophilic material was then concentrated and analyzed by gas chromatography and mass spectrometry detection. Finally, synthesis was employed to aid identification and to provide material for biological and chemical tests. The chlorinated furanones 1. 2a. 2b. and 3 are formed only in trace for biological and chemical tests. The chlorinated furanones 1, 2a, 2b, and 3 are formed only in trace amounts during the chlorination of softwood kraft pulp and humic acid. The kappa number of unbleached pulp is reduced by oxygen prebleaching prior to bleaching with chlorine. In the case of numic acid, the furanones were only detected readhumic acid, the furanones were only detected readily when chlorinations were performed under favorable conditions. Chemical stability tests also indicate these compounds are unstable at neutral pH. Although it is unlikely that these furanones constitute an environmental hazard in receiving waters, their significance with respect to drinking water is unknown. (See also W90-06906) (Fish-PTT) W90_06016

TOXICOLOGICAL SIGNIFICANCE OF THE CHEMICAL REACTIONS OF AQUEOUS CHLORINE AND CHLORAMINES.

Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.

For primary bibliographic entry see Field 5F.

FORMATION OF AROMATIC POLYMERS DURING THE OZONATION OF ENZYMATIC OXIDATION OF WATERS CONTAINING PHE-NOLIC COMPOUNDS,

Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France). For primary bibliographic entry see Field 5F.

BY-PRODUCTS FROM OZONATION AND PHOTOLYTIC OZONATION OF ORGANIC POLLUTANTS IN WATER: PRELIMINARY

For primary bibliographic entry see Field 5F. W90-06921

ENVIRONMENTAL CHEMISTRY AND TOXI-COLOGY OF ALUMINUM.
Proceedings of a Symposium held during the 194th Annual Meeting of the American Chemical Socie-ty in New Orleans, La. on August 30 through September 4, 1987. Lewis Publishers, Chelsea, Michigan. 1989. 344p.

Descriptors: *Acid rain, *Aluminum, *Fate of pol-L'escriptors: "Acid rain, "Aluminum, "Fate of pol-lutants, "Path of pollutants, "Symposium, "Toxi-cology, "Water pollution sources, Chemical analy-sis, Chemical reactions, Environmental effects, En-vironmental quality, Pollutant identification, Re-search priorities, Scientific personnel, Speciation, Toxicity.

Aluminum is the most abundant metal and the third most abundant element, composing 8% of the earth's crust. A broad overview is offered of the sources, transport, and fate of aluminum in the environment. Each chapter represents a detailed summary of discussions presented at a three-day symposium entitled 'The Environmental Chemistry of Aluminum,' held during the 194th Annual Meeting of the American Chemical Society in 1987. Some chapters present results of original research, while others offer a review of the scientific literature. Topics include aluminum mobilization by acidic deposition, speciation, environmental chemistry, toxicity, analytical techniques and methodology. Effects of aluminum in the environment are highly dependent upon the form in which aluminum occurs are as numerous as the scientific aluminum occurs are as numerous as the scientific disciplines studying this element. The necessity for unscriptines studying this element. The necessity for interaction between scientists working in all facets of aluminum chemistry and toxicology is essential for setting wise future research goals and making sound regulatory decisions. (See W90-06929 thru W90-06941) (Fish-PTT) W90-06929

STABILITY OF ALUMINUM SPECIES IN A NATURAL AUDIT SAMPLE: POSSIBLE APPLICATION AS A QUALITY CONTROL SOLU-

ockheed Engineering and Sciences Co., Inc., Las Vegas, NV. L. J. Arent, and T. E. Lewis

L. J. Arent, and T. E. Lewis.
In: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan.
1989. p 41-57, 5 fig, 3 tab, 37 ref.

Descriptors: *Acid rain, *Aluminum, *Chemical analysis, *Environmental effects, *Lakes, *Path of pollutants, *Quality control, *Water analysis, *Water chemistry, Analytical techniques, Cation exchange, Colorimetry, Hydrogen ion concentration, Natural waters, Organic compounds, Precision, Surface water data, Surveys, Temperature, Water sampling.

Mobilization of toxic elements from soils and sedi MODIZATION of toxic elements from soils and sediments has been of growing concern as a result of acidic deposition. Aluminum is subject to increased mobility at lower pH levels in soil and surface waters, and is known to be highly phytotoxic. Toxicity is correlated with inorganic monomeric Al. Obtaining reliable precision and accuracy estimates for a citizen Al applying septeme is difficult. mates for a given Al analytical scheme is difficult. A survey was conducted by the EPA in 1986 to characterize the chemical status of surface waters in the northeastern U.S. An important component

of the quality control (QC) regimen was the use of natural waters as audit samples. One of the natural audit samples was used as a QC sample for the determination of total monomeric Al and nonexchangeable monomeric Al, examined in a single changeable moments At, examined in a single matural audit sample over the 38-day synoptic lake study. A short-term (16-day) experiment was also run to examine the stability of the natural audit sample. A colorimetric method involving the complexation of monomeric Al by pyrocatechol violet (PCV) was used on a two-channel flow injection system. The natural audit sample was used as a daily QC sample for the determination of mono-meric Al species. It was found that the natural audit sample contained stable concentrations of organically-bound Al, and was successfully used to organicany-outh Ar, and was successfully listed to determine removal efficiency of exchangeable (in-organic monomeric) Al by the cation exchange column. It provides both inorganic and organic Al fractions, provided precautions are taken to minimize change in sample temperature and pH. Natural samples with similar matrices may also serve as viable QC samples for the determination of Al species. (See also W90-06929) (Fish-PTT) W90-06932

MODELING THE INTERACTIONS OF AL SPECIES, PROTONS AND CA(2+) WITH HUMIC SUBSTANCES IN ACID WATERS AND

Freshwater Biological Association, Ambleside (England).

E. Tipping, C. A. Backes, and M. A. Hurley. IN: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan. 1989. p 59-82, 10 fig, 8 tab, 33 ref.

Descriptors: "Acid rain, "Aluminum, "Humic substances, "Metal complexes, "Model studies, "Path of pollutants, "Water chemistry, Acidic soils, Acidic water, Binders, Buffering, Calcium compounds, Environmental effects, Equilibrium, Hydrogen ion concentration, Model testing, Specia-

High concentrations of dissolved aluminum are a major feature of acid environments. The soluble major reature of acid environments. The soluble metal exists as a variety of species among which are complexes of Al(+3) and AlOH(+2) with humic substances (HS). It is necessary to model the metal-humic interactions so that extents of binding in acid waters and soils can be calculated, given appropriate input data. This would be helpful in predicting the effects of changes in environmental predicting the effects of changes in environmental conditions on Al speciation and can be used to calculate proton buffering by the Al-HS complexes, and thereby to predict solution pH in cases where such complexes dominate. The general approach to determining parameter values is the analysis of acid-base titration data. Direct measurements of Al binding were made, and these were compared with predicted values in order to test the model. The model developed appears to describe the equilibria involving HS, Al species, Ca(+2), and H(+) under acid conditions to at least a good first approximation. Further developments could first approximation. Further developments could be made to improve upon the highly simplified be made to improve upon the highly simplified formulation of bulk solution/diffuse layer concentration relationships and to increase the number of permitted types of metal-binding site in order to improve data-fitting. The model should be useful in predicting approximately how the chemistry of acid environments responds to changing conditions. (See also W90-06929) (Fish-PTT) W90-06933

CHEMISTRY AND TRANSFER OF ALUMINUM IN A FORESTED WATERSHED IN THE ADIRONDACK REGION OF NEW YORK, USA. Institute for Ecosystem Studies, Millbrook, NY. C. T. Driscoll, B. J. Wyskowski, P. DeStaffan, and

In: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan. 1989. p 83-105, 6 fig, 7 tab, 38 ref.

Descriptors: *Acid rain, *Aluminum, *Path of pol-lutants, *Soil genesis, *Water chemistry, *Weath-ering, Acidic soils, Acidic water, Cations, Deposi-tion, Dissolved solids, Drainage water, Ground-

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water movement, Lysimeters, Mass transport, Monitoring, New York, Nutrient transport, Organ-ic compounds, Soil analysis, Soil gases, Soil hori-zons, Soil organic matter, Stream classification, Water quality, Watersheds.

Water quality, Watersheds.

The transport of aluminum (Al) is an important aspect of the development of soils in northern temperate regions. Variations in soil water and stream composition were monitored, as well as selected stream sediment parameters in a small acid-sensitive forested watershed located within the west-central Adirondack region of New York during the fall of 1985. The watershed was instrumented for hydrologic and water quality monitoring. Lysimeters and soil gas collectors were placed in two soil pits. Aliquots of soil were collected for analysis of free (non-silicate bound) Al fractions. It was found that drainage waters from the watershed were highly acidic due to elevated inputs of H2SO4 and HNO3 relative to the limited release of basic cations. These conditions facilitated the mobilization of soil Al. Alumino-organic solutes were largely derived from the soil organic horizon, while inorganic monomeric Al was released from the mineral soil and to a lesser extent from the organic horizon. Drainage water Al was largely in an inorganic monomeric form, with aquo an inorganic monomeric form, with aquo Al((Al+3)) predominating. Mass transport calcula-Al((Al+3)) predominating. Mass transport calculations suggest that the near-stream/in-stream environment is a zone of Al retention. Organic monomeric Al deposition coincided with dissolved organic carbon retention, while NO(3-) retention appeared to facilitate the deposition of inorganic monomeric Al. Hydrolysis/deposition of Al along the terrestrial/aquatic interface may influence nutrient cycling and could serve as an important source of mobile Al during episodic acidification. (See also W90-06929) (Fish-PTT)

HOW ALUMINUM LEVELS IN SUBSURFACE DRINKING WATER SUPPLIES IN CANADA CAN BE USED TO PREDICT POSSIBLE IMPACT BY ACIDIC DEPOSITION. Health and Welfare Canada, Ottawa (Ontario). En-

vironmental Health Centre. J. C. Meranger.

J. C. Meranger. In: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan. 1989. p 107-116, 5 fig, 14 ref.

Descriptors: *Acid rain, *Aluminum, *Canada, *Environmental impact, *Groundwater pollution, *Indicators, *Water chemistry, *Water quality, *Water sampling, Alkaline water, Drinking water, Field tests, Hydrogen ion concentration, Infiltration rate, Model studies, Nova Scotia, Ontario, Path of pollutants, Porosity, Subsurface water, Test wells.

Very little information is available on the impact of Very little information is available on the impact of acid rain on groundwater supplies in Canada. Recently, some 500 surface and groundwater samples selected from three areas of Canada were analyzed for major and trace elements. The sampling areas were chosen to represent a range of acidic deposition and a model was proposed to study the impact of this acidic deposition on the quality of surface and groundwater supplies in these areas. A field study on extractable aluminum was also conducted in Ontario and Nova Scotia. Preliminary results indicate that monomeric aluminum accounts for a in Öntario and Nova Scotia. Preliminary results indicate that monomeric aluminum accounts for a significant portion of the total aluminum present in shallow overburden wells whose pH values fall below 6.0, while greater amounts of insoluble aluminum are present in more alkaline waters. The higher levels of aluminum in low pH, shallow groundwater most probably reflect more rapid infiltration of acid surface water and acidic precipitation through porous overburden. There is increasing evidence linking acidic deposition to changes in the water quality of subsurface water supplies in Canada. Aluminum may be used in the future as an index to predict changes in the overall drinking index to predict changes in the overall drinking canaus. Atumnuum may be used in the future as an index to predict changes in the overall drinking water quality of areas affected by acidic deposition. (See also W90-06929) (Fish-PFT) W90-06932

EPISODIC VARIATIONS IN STREAMWATER ALUMINUM CHEMISTRY AT BIRKENES, SOUTHERNMOST NORWAY.

Senter for Industriforskning, Oslo (Norway). H. M. Seip, N. Christophersen, and T. J. Sullivan. IN: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan. 1989. p 159-169, 5 fig, 26 ref.

Descriptors: *Acid rain, *Aluminum, *Model studies, *Norway, *Path of pollutants, *Seasonal variation, *Surface water, *Water chemistry, Acidic soils, Acidic water, Base flow, Biological studies, Equilibrium, Flow discharge, Model testing, Organic matter, Saturation, Snowmelt, Soil chemistrians Soil becomes Soil bec try. Soil horizons, Storm water.

The detailed mechanisms controlling aluminum concentrations in acidic surface water and soils are far from understood. Models for water acidification usually assume simple equilibrium with solid aluminum hydroxide (gibbsite). Improved knowledge of aluminum chemistry is of great importance for predicting surface water chemistry and related biological effects under various scenarios of acid deposition. Detailed studies of stream and soil water chemistry were carried out at Birkenes, southernmost Norway. The observed large in-crease in inorganic Al when discharge increases crease in inorganic Al wine discharge increases after long base flow periods may cause greater biological stress than during later episodes when peak concentrations of inorganic Al are similar, but the fluctuations less. Early snowmelt is likely to be particularly toxic to fish since it is the only period when high concentrations of inorganic aluminum occur in a solution close to saturation. The variations in Al concentrations in the Birkenes stream corroborate earlier observations, where the highest Al values found were early in the snow-melt followed by a dilution. However, increased melt followed by a dilution. However, increased concentrations were observed after the snowmelt. Streamwater was highly undersaturated with respect to synthetic gibbsite at low pH. Model validation using detailed short-term observations is necessary. An improved model for stream and soil water chemistry must take into account that discharge is pre-event water, soil water ion stability, and interception of organic horizons. A model emphasizing dynamic interchange of water between upper acidic soils and the mineral soils during stormflow may lead to a more realistic description of water pathways. (See also W90-06929) (Fish-PTT)

ALUMINUM CHEMISTRY OF ACIDIC SANDY SOILS WITH VARIOUS INPUTS OF ACIDIC DEPOSITION IN THE NETHERLANDS AND IN DENMARK

Agricultural Univ., Wageningen (Netherlands). J. Mulder, N. Van Breemen, L. Rasmussen, and C. T. Driscoll.

IN: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan. 1989. p 171-194, 4 fig, 10 tab, 33 ref. EEC Contract ENV-650-NL.

Descriptors: *Acid rain, *Acidic soils, *Aluminum, *Chemical analysis, *Denmark, *Path of pollutants, *Soil chemistry, *The Netherlands, Cations, Equilibrium, Leaching, Model testing, Monitoring, Nutrient removal, Roots, Sand, Saturation zone, Silicates, Solubility, Throughfall, Vegetation, Water quality, Water transport.

Increased inorganic monomeric aluminum (Al) concentrations have been observed in drainage water from acidic, sandy soils in parts of North America and Northwestern Europe, indicating that the Al chemistry of these soils has changed. In order to test the hypothesis (in situ) that acidic descriptions. order to test the hypotnesis (in stud) that acidic deposition is the main cause for the observed increase in Al mobilization, six sandy, acidic soils in the Netherlands and in Denmark were selected. The monitoring program included (1) the determination of the quantity and chemical composition of throughfall water, (2) chemical analysis of soil solutions, (3) estimation of waterfluxes in the soil using new transparent model and (4) estimation. using a water transport model, and (4) estimation of the annual nutrient uptake by vegetation. It was concluded that atmospheric acid has a strong impact on the Al chemistry of acidic, sandy soils, which are highly vulnerable to acidic deposition. Their base saturation is low and the rate of basic cation weathering does not increase with the rate

of acid input. Any additional strong acid deposi-tion in these soils is almost exclusively neutralized by Al solubilization. Al concentrations in the surby Al solubilization. Al concentrations in the sur-face soils are relatively low and may be in equilib-rium with free (organically-bound) soil Al, which is probably least soluble in the surface horizons, where most of the Al leaching has occurred. The source of mobilized Al is mostly free, non-silicate source of mobilized Al is mostly free, non-silicate bound Al, which will be exhausted rapidly at the present high Al leaching rate. The strong impact of atmospheric acid input on the Al chemistry of the soil may not only result in negative effects on nutrient solutions in the rooting environment, and on ground and surface water quality, but may also dramatically change pedogenetic processes. (See also W90-06929) (Fish-PTT) W90-06937

ALUMINUM SPECIATION AND ORGANIC CARBON IN WATERS OF CENTRAL ONTAR-

Ontario Ministry of the Environment, Toronto. B. D. LaZerte.

In: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan. 1989. p 195-207, 7 fig, 3 tab, 19 ref.

Descriptors: *Acid rain, *Aluminum, *Canada, *Chemical speciation, *Dissolved organic carbon, *Path of pollutants, *Water chemistry, Catchment areas, Environmental effects, Lakes, Lysimeters, Minerals, Model testing, Monitoring, Ontario, Organic compounds, Sinks, Soil horizons, Soil profiles, Streams, Surface water, Water pollution sources, Wetlands.

The Muskoka-Haliburton region of Central Ontario contains acidified lakes and streams, with relatively high levels of aluminum (Al) in the acidified streams. Over the two-year period of 1987-1988, a series of 26 different steams in two catchments, and 60 lysimeters at different locations in the catchments and soil profiles, have been monitored in an attempt to determine sources, sinks, and forms of attempt to determine sources, sinks, and forms of aqueous Al. It was found that soils and surface waters in this region of Central Ontario exhibit well-defined regional sources and sinks of inorgan-ic and organic monomeric Al. For inorganic monomeric Al, the source is the Bh soil horizon monomeric Al, the source is the Bh son horizon and the sink is all downstream locations. Organic monomeric Al and dissolved organic carbon (DOC) is obtained from two widely separated sources: the soil LFH horizon and wetlands. The sources: the soil LFH horizon and wetlands. The mineralogical source and sink of inorganic monomeric AI appears to be some aluminum trihydroxide solid phase, and it can be effectively predicted in low DOC waters by assuming equilibrium with this phase. In waters higher in DOC, mineralogical control does not always occur. Nonetheless, the separation between free and organic AI can be effectively predicted in high DOC waters using a Backes and Tipping type of chemical equilibrium model. There does not appear to be a universal set of coefficients that apply to all environments. (See also W90-06929) (Fish-PTT)

ALUMINUM SPECIATION AND TOXICITY IN

Water Research Centre, Medmenham (England). A. J. Dobbs, P. French, A. M. Gunn, D. T. E. Hunt, and D. A. Winnard. IN: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan. 1989. p 209-228, 11 fig, 3 tab, 18 ref.

Descriptors: *Acid rain effects, *Aluminum, *Bacterial analysis, *Environmental effects, *Microtox assay, *Natural waters, *Speciation, *Toxicity, *Toxicotyq, *Water chemistry, Bioluminescence, Equilibrium, Fate of pollutants, Field tests, Fish toxins, Fluorides, Hydrogen ion concentration, Metal complexes, Organic compounds, Solubility, Thermodynamics. Thermodynamics.

Since the main objective of speciation studies in natural waters is to determine the effects on biota it is essential that experimental analytical speciation studies are conducted in concert with toxicity or bioavailability studies. The Microtox system, based

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on the bioluminescent response of reconstituted freeze-dried bacteria, was selected for use with an on-line field system to monitor aluminum (Al) speciation and pH in conjunction with fish-stress measurements. Thermodynamic calculations were used both to aid interpretation of the speciation/ toxicity experiments and to model Al speciation and solubility in typical natural waters. Calculations indicate that equilibrium constants for reaction of Al with natural organics are important in natural waters. The toxicity studies with luminescent bacteria showed clearly the strong dependence of Al toxicity on speciation. Al complexes with citric acid, fluoride, and organics in natural water samples were shown to be less toxic than uncomplexed Al. In the case of fluoride, however, the results may imply some toxicity from the Al complexes. A consistent picture was produced of Al toxicity in the presence of natural organics. It is measurements. Thermodynamic calculations were compiexes. A consistent picture was produced of Al toxicity in the presence of natural organics. It is now clear that there is a strong relationship be-tween Al speciation and toxicity. Total Al determi-nations alone are therefore of limited use for monitoring or assessing environmental effects.
combination of on-line Al speciation instrur with a fish-stress monitor provides a powerful tool for further study of the role of Al in acid episodes which are of critical importance in upland waters.
(See also W90-06929) (Fish-PTT)

COMPOSITION AND CONSEQUENCES OF ALUMINUM IN WATER, BEVERAGES AND OTHER INGESTIBLES.

Bjorksten Research Foundation, Madison, WI. Björksten Research Foundation, Mathson, W.I. R. U. Schenk, J. Björksten, and L. Yeager. IN: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan. 1989. p 247-269, 7 tab, 17 ref.

Descriptors: *Aluminum, *Animal metabolism, *Drinking water, *Foods, *Population exposure, Atomic absorption spectrophotometry, Bioaccumulation, Blood, Chemical analysis, Toxicology, Water pollution sources, Water quality, Water sampling

Aluminum (Al) is one of the most common metals in the environment, but is not a part of any known animal metabolic process. This raises questions as to the potential harmful effects of this element. A to the potential nammul effects of this element. A substantial number of beverages, foods, and water sources have been analyzed for Al content over the years. However, it was desirable to obtain data on a wide range of water sources, beverages, foods, and other substances that may be ingested, utilizing current methodology. Water samples from several sources in over 20 states and 3 foreign countries were analyzed on a storic abscration. countries were analyzed on an atomic absorption spectrophotometer, along with many common bevspectrophotometer, along with many common beverages and a moderate number of foods, primarily dry solids. Most drinking water was found to have less than 100 parts per billion of Al, suggesting that water is not normally a major source for Al ingestion. Beverages, with the exception of fruit juices, tend to have a substantially higher Al content than does water. All carbonated beverages have substantially higher but quite variable Al contents. Teas, which are reported to accumulate Al in the plant's tissues, were indeed found to produce bevleas, which are reported to accumulate Al in the plant's tissues, were indeed found to produce beverages with a high Al content. Herbal teas tended to be substantially lower in Al than were the regular teas. Wines generally had higher Al concentrations than did distilled liquors. Food products show extremely wide variations in Al content. Analyses of other substances which are ingestible showed that many of these products, e.g., antacids, had very high Al contents. In future studies, it is particularly important to establish whether all sources of Al are harmful; Al which is not ab-sorbed from the intestinal system into the blood is presumably of little concern from a health stand-point. (See also W90-06929) (Fish-PTT) W90-06941

HANDBOOK OF ENVIRONMENTAL FATE AND EXPOSURE DATA FOR ORGANIC CHEMICALS, VOLUME II: SOLVENTS.

Lewis Publishers, Inc., Chelsea, Michigan. 1990. 546 p. Edited by Philip H. Howard, Gloria W. Sage, William F. Jarvis, and D. Anthony Gray.

Descriptors: *Fate of pollutants, *Handbooks, *Organic compounds, *Path of pollutants, *Population exposure, *Solvents, Adsorption, Biodegradation, Chemical properties, Databases, Degradation, Hydrolysis, Information retrieval, Photolysis, Physical properties Volutilization. cal properties, Volatilization.

This book outlines in detail how individual sol-This book outlines in detail how individual soluents are released, transported, and degraded in the environment and how they are exposed to humans and environmental organisms. The chemicals are listed in alphabetical order by the name considered to be the most easily recognized. For each chemical, the physical properties as well as the environmental fate and monitoring data were identified by conducting searches of the Environmental Fate Data Bases of Syracuse Research Corporation (SRC). Each substance is identified with synonyms, structure, CAS Registry number, moporation (SRC). Each substance is identified with synonyms, structure, CAS Registry number, mo-lecular formula, and the Wiswesser line notation. Data for the environmental fate/exposure potential were identified with SRC's Environmental Fate Data Bases. Biodegradation data were selected from the DATALOG, BIOLOG, and BIODEG from the DATALOG, BIOLOG, and BIODEG files. Abiotic degradation data were identified in the hydrolysis, photolysis, and oxidation fields in DATALOG and CHEMFATE. Transport processes such as bioconcentration, soil adsorption/mobility, and volatilization as well as the monitoring data were also identified in the DATALOG and CHEMFATE files. (Lantz-PTT)

TOXIC TRACE ELEMENTS AND CHLORIN-ATED HYDROCARBONS: SOURCES, ATMOS-

ATED HYDROCARBONS: SOURCES, ATMOS-PHERIC TRANSPORT AND DEPOSITION.
Norsk Inst. for Luftforskning, Lillestroem.
A. Semb, and J. M. Pacyna.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE88-756607.
Price codes: AO4 in paper copy, AO1 in microfiche.
January 1988. 96p, 11 fig, 19 tab, 220 ref. Norsk Inst. for Luftforskning Project 0-8546.

Descriptors: *Air pollution, *Chemistry of precipitation, *Chlorinated hydrocarbons, *Path of pollutants, *Toxic wastes, *Trace elements, *Water pollution sources, Deposition, Mercury, Pesticides, Polychlorinated biphenyls, Water pollution.

Toxic trace elements and chlorinated hydrocarbons represent a special class of environmental contaminants, because of their strong bioaccumula-tion and persistence. Atmospheric transport and deposition by precipitation scavenging and dry deposition is an important source of these sub-stances in terrestrial and aquatic ecosystems. The processing of mineral resources at high tempera-tures results in releases of volatile elements to the atmosphere. Some of these elements, e.g., As, Cd, and Pb, have been widely studied due to the serious health concern associated with them, and quantitative emission data are becoming available for many European countries. Once emitted to the for many European countries. Once emitted to the atmosphere, trace elements can be transported within air masses and deposited in remote areas, and source-receptor models have been formulated which can be used to relate measured concentrawinter can be used to leate measured concentra-tions in air to estimated emissions. Large quantities of elemental mercury and gaseous mercury com-pounds are released by combustion processes, and the deposition of other air pollutants. The chlorinthe deposition of other air pollutants. The chlorinated hydrocarbons of concern are pesticides, industrial chemicals or additives, and compounds formed as undesirable byproducts in industrial and combustion processes. Deposition from atmosphere is the most important source for the occurrence of chlorinated hydrocarbons in terrestrial and aquatic food chains. Restrictions on the use of polychlorinated biphenyls in the 1970's have not been effective in reducing concentrations in ambient air and precipitation. (Lantz-PTT) W90.06948

ORGANIC CARBON IN WATERS OF THE WHITE SEA DURING THE SUMMER OF 1984.

All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).

M. P. Maksimova, and S. S. Vladimirskiy.
Oceanology ONLGAE, Vol. 28, No. 5, p 585-589, April 1988. 2 fig, 8 ref.

Descriptors: *Annual runoff, *Organic carbon, *Seasonal distribution, *White Sea, Anthropogenic

The first information on the concentration and distribution of organic carbon in the White Sea for the period of intense anthropogenic impact have obtained; previous data were obtained during the background period, i.e. the late 1950s. The lateral distribution of organic carbon in the White Sea, which is strongly affected by river runoff, is highly variable (from 2.5 to 8 mg of carbon/L in estuarine areas) and is governed by the dynamic interaction of water masses of different origins. The maximum organic carbon content of the surface water mass (mean 4.68 mg/L, plus or minus 0.13 mg) is considerably lower in water masses (3.32 mg/L, plus or minus 0.14 mg/L). The current weighted mean concentration of organic carbon in the waters of the White Sea is estimated to be 3.5 mg of carbon per liter. (Author's abstract) W90-06957 The first information on the concentration and W00.06057

RADIONUCLIDE PARTITIONING ACROSS GREAT LAKES NATURAL INTERFACES.

National Water Research Inst., Burlington (Ontar-io). Lakes Research Branch. 10). Lates Research Blanch. R. F. Platford, and S. R. Joshi. Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 3, p 183-186, November/ December 1989. I fig. 2 tab, 20 ref.

Descriptors: *Lake Ontario, *Limnology, *Niaga-ra River, *Path of pollutants, *Radioisotopes, *Surface microlayer, Cesium radioisotopes, Lead radioisotopes, Pollutant identification, Radium ra-dioisotopes, Sediment contamination, Suspended solids, Thorium radioisotopes.

Several water and surface microlayer samples from Lake St. Clair, the Niagara River, and the North Shore of Lake Ontario collected during 1983-1986 have been assayed for a variety of radionuclides. In addition, the foam accumulating in the pool just below Niagara Falls was also analyzed and found to be the most efficient aqueous phase collector of 137Cs, 210Pb, and 226Ra. The order of radioiso-tope specific activities from highest to lowest is: Lake Ontario sediment, Niagara River suspended solids, Niagara River foam, surface microlayer water, and subsurface water. Radiological dose rates to the sediments from 137Cs, 226Ra, and 228Th total only about 5 mGy/Y. None of the radionuclides in the Lake Ontario region occurs at unusually high activities; the dose rate to the sediments at the mouth of the Niagara River is 2-3 times that due to normal background radiation. (Author's abstract) (Author's abstract) W90-06961

ENVIRONMENTAL INFLUENCE OF A VOL-CANIC PLUME, A NEW TECHNIQUE OF STUDY, MOUNT ETNA, SICILY.

Luton Coll. of Higher Education (England). Dept.

For primary bibliographic entry see Field 5A.

DILUTION MIXING ESTIMATES OF TRACE METAL CONCENTRATIONS IN SUSPENDED SEDIMENTS.

Maryland Univ., College Park. Dept. of Geogra-For primary bibliographic entry see Field 5A.

EPHEMERAL FOREST DRAINAGE DITCH AS A SOURCE OF ALUMINIUM TO SURFACE WATERS.

Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station B. Reynolds, and S. Hughes.

Science of the Total Environment STENDL, Vol. 80, No. 2/3, p 185-193, May 1989. 3 fig, 2 tab, 18

Group 5B-Sources Of Pollution

Descriptors: *Acid rain effects, *Aluminum, *Drainage ditches, *Forest watersheds, *Water pollution sources, Catchment areas, Drainage effects, Organic carbon, Stream pollution, Surface water data Weathering

Chemical data was collected for water flowing in an emphemeral forest drainage ditch. The water was acidic (pH 3.96-4.16), aluminum bearing, and with a high concentration of dissolved organic carbon (300-500 micromol C/L. Aluminum was present mainly in the labile monomeric form, the concentration of which increased downstream in concentration of which increased downstream in the ditch. This was accompanied by a decrease in hydrogen ion and dissolved organic carbon con-centrations. Concentrations of base cations and inorganic anions remained approximately constant along the length of the ditch. Readily soluble phases, such as poorly crystalline to amorphous aluminum hydroxides, iron-aluminum hydroxides and aluminum hydroxysilicates in the soil compris-ing the ditch walls and base, provide a source of aluminum to solution via weathering. (Author's abstract)

INORGANIC ALUMINIUM-HYDROGEN ION RELATIONSHIPS FOR ACIDIFIED STREAMS; THE ROLE OF WATER MIXING PROCESSES. Institute of Hydrology, Wallingford (England). C. Neal, and N. Christopherson. Science of the Total Environment STENDL, Vol. 80, No. 2/3, p 195-203, May 1989. 2 fig, 1 tab, 24

Descriptors: *Acid rain effects, *Acid streams, *Acidification, *Aluminum, *Hydrogen ion concentration, *Model studies, *Path of pollutants, *Storm runoff, *Water chemistry, Base flow, Catchment areas, Control systems, Soil water.

Streamwaters draining acidified catchments usually exhibit large fluctuations in aluminum and hydrogen ion concentrations which are positively correlated with flow. Stormflow waters are mainly derived from waters passing through the upper acidic and aluminum bearing soil zones. Baseflow waters are derived from the lower soil/groudwater waters are derived from the lower soil/groudwater zones where inorganic reactions prevail and hy-drogen ions generated in the upper soil are con-sumed. In several cases these variations in stream-water chemistry cannot be explained by solubility control of a single mineral phase such as micro-crystalline or natural gibbsite. In three such catchments, the controlling mechanisms are explored in terms of both conservative and non-conservative terms of both conservative and non-conservative two-component mixing of upper soil and ground waters. It was concluded for this exercise, linear concentration plots are the best tools. The commonly used log-log plots lead to a confounded picture masking important insights. (Author's abstract) W90-06977

PREDICTING THE LONG-TERM VARIATIONS IN STREAM AND LAKE INORGANIC ALUMINIUM CONCENTRATIONS FOR ACIDIC AND ACID SENSITIVE CATCHMENTS.

Institute of Hydrology, Wallingford (England).
C. Neal, T. Musgrove, and P. G. Whitehead.
Science of the Total Environment STENDL, Vol. 80, No. 2/3, p 205-211, May 1989. 2 fig, 25 ref.

Descriptors: *Acid lakes, *Acid rain effects, *Acid streams, *Acidification, *Aluminum, *Catchment areas, *Model studies, *Water quality, Data interpretation, Hydrogen ion concentration, Scotland, Wales.

A modification to the one-box version of the Model of Acidification of Groundwater in Catch-ments (MAGIC) for stream and lake acidification is given. This model presents a new hypothesis for describing inorganic aluminium controls in streams draining acidic catchments. This modification en-tails the removal of any assumption of Al(OH)3 solubility control in the stream. Success of this modification is demonstrated for data collected from a regional survey of Welsh streams and lakes. The modified model is used with data from the

acidic and acid impacted of Dargall Lane catchment of the Galloway region of South West Scotland to provide an example of the long-term changes in stream acidity and inorganic aluminum concentration. (Author's abstract)

FLUORINE VARIATIONS IN WEI STREAMS AND SOIL WATERS. Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 5C. W90-06979

SOURCES AND STORM LOADING VARIATIONS OF METAL SPECIES IN A GULLY-POT CATCHMENT.

Middlesex Polytechnic, Enfield (England). Urban

Middlesex Polytecanic, Edited Cappania, Vision Pollution Research Center.
G. M. Morrison, D. M. Revitt, and J. B. Ellis. Science of the Total Environment STENDL, Vol. 80, No. 2/3, p 267-278, May 1989. 5 fig, 2 tab, 22

Descriptors: *Catchment basins, *Heavy metals, *Highway runoff, *Pollution load, *Storm runoff, *Storm water, *Urban runoff, *Water pollution sources, Cadmium, Copper, Flow discharge, Lead, Outfall, Sediment-water interfaces, Water quality control, Zinc.

The temporal variations of metal species in the outflow from a gullypot catchment are discussed for two storms with differing hydrological characteristics. The major contributing sources within the systems are identified from an analysis of six discrete storm events. Under low flow conditions the crete storm events. Under low flow conditions the dissolved metals are complexed by organics present in the gullypot liquor and interstitial sediment waters, and the strongly bound fraction predominates in the gullypot outflow. As the flow increases the Chelex removable fraction becomes important due to acid washing initially of road-surface sediments and subsequently of the mobilized gullypot sediments. The particulate-associated metals exhibit distinct temporal similarities to the storm hydrograph and chemograph for suspended solids with the exchangeable fraction being dominant. Hydrodynamic sorting mechanisms on the road surface produce the earlier contributions for this fraction, with later inputs, particularly for for this fraction, with later inputs, particularly for cadmium and lead, from chemical exchange proccammin and each from chemical exchange processes within overturned gullypot sediment. This basal sediment also provides important inputs of the carbonate and hydrous oxide fraction for copper and zinc as the gullypot contents become oxygenated later in the storm. The consequences of these findings are discussed in terms of gullypot maintenance and the water quality of stormwater outfalls. (Author's abstract)

AQUATIC TOXICOLOGY.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.

Environmental Science and Technology ESTHAG, Vol. 24, No. 2, p 154-161, February 1990. 3 fig. 18 ref. J. Cairns, and D. I. Mount.

Descriptors: *Bioassay, *Fate of pollutants, *Path of pollutants, *Toxicology, *Water pollution effects, Data interpretation, Environmental protection, Experimental design, Laboratory methods, Microorganisms, Uncertainty, Water properties, Water quality control.

Ecotoxicology is the study of the fate and effect of toxic agents in ecosystems, with the goal of protecting natural systems and their inherent organisms. Water hardness, pH, suspended solids, total organic carbon, and temperature (to mention just a few characteristics) may markedly affect the expression of toxicity for a particular chemical compound. A standardized or 'artificial' water can be made by adding appropriate constituents to distilled water, or natural waters can be used from above the source of contamination. Use of natural water increases the difficulty of replication because water increases the difficulty of replication because natural waters vary considerably. The goals of

aquatic testing are to determine which types of toxicity tests will reduce uncertainly most cost effectively and to determine at what point the uncertainty has been sufficiently reduced to allow an informed professional judgement. For sub-stances such as chlorine or some detergents that stances such as choined to something less hazard-ous or are eliminated from the aquatic ecosystem, a short-term toxicity test will probably suffice except when the material is continuously discharged and concentrations persist near the outfall. However, many chemicals are persistent and their exposure time in natural systems is likely to be much longer than is normally used in routine tests. A partial solution to this problem may be to extrapolate from a species with a short life cycle to one with an intermediate life cycle, for example, from Ceriodaphnia to fathead minnows. For regulatory pur-poses, it is unquestionably sound to use test orga-nisms that have been widely used for toxicity testing and whose strengths and weaknesses for testing and whose strengths and weaknesses for this purposes are well known. At the same time, the information base on relative responses must be continually expanded. Aquatic toxicity testing using microorganisms may become more common due to concerns about the ethics of animal testing. There is persuasive evidence that there is a high correspondence between the responses of microbi-al species and those of the more commonly-used test species. (Agostine-PTT) W90-06990

MOBILITY OF PLUTONIUM AND AMERICI-UM THROUGH A SHALLOW AQUIFER IN A SEMIARID REGION.

Transducer Research, Inc., Naperville, IL. W. R. Penrose, W. L. Polzer, E. H. Essington, D. M. Nelson, and K. A. Orlandini.

Environmental Science and Technology ESTHAG, Vol. 24, No. 2, p 228-234, February 1990. 4 fig. 6 tab, 33 ref. US DOE OHES Subsur-face Science Program Contract W-31-109-ENG-

Descriptors: *Groundwater pollution, *Path of pollutants, *Radioactive wastes, *Semiarid lands, Actinide radioisotopes, Aquifers, Fate of pollutants. New Mexico.

Treated liquid wastes containing plutonium and americium are released into Mortandad Canyon, within the site of Los Alamos National Laboratory, NM. The wastes infiltrate a small aquifer within the canvon. Although laboratory and aquifer within the canyon. Although laboratory studies have pre-dicted that the movement of actinides in subsurface environments will be limited to less than a few meters, both plutonium and americium are detectameters, both plutonum and americium are detecta-ble in monitoring wells as far as 3390 m downgra-dient from the discharge. Between the first and last monitoring wells (1.8 and 3.4 km from the dis-charge), plutonium concentrations decreased ex-ponentially from 1400 to 0.55 mBq/L. Americium concentrations ranged between 94 and 1240 mBq/ t, but did not appear to vary in a systematic way with distance. Investigation of the properties of the mobile actinides indicates that the plutonium and part of the americium are tightly or irreversibly associated with colloidal material between 25 and associated with colloidally bound actinides are 450 nm in size. The colloidally bound actinides are removed only gradually from the groundwater. The fraction of the americium not associated with colloids exists in a low molecular weight form (diameter, less than or equal to 2 nm) and appears to be a stable, anionic complex of unknown composition. The mobile forms of these actinides defeat the forces that normally act to retard their movement through groundwater systems. (Authors abstract) thor's abstract)

CONCEPTUAL MODEL OF ORGANIC CHEM-ICAL VOLATILIZATION AT WATERFALLS, Toronto Univ. (Ontario). Inst. for Environmental

M. McLachlan, D. Mackay, and P. H. Jones. Environmental Science and Technology ESTHAG, Vol. 24, No. 2, p 252-257, February 1990. 3 fig, 1 tab, 32 ref.

Sources Of Pollution—Group 5B

Descriptors: *Mathematical models, *Path of pollutants, *Volatilization, *Waterfalls, Air pollution sources, Model testing, Niagara Falls, Organic

It is possible that waterfalls significantly affect the fate of many organic compounds in rivers and act as 'point sources' of atmospheric contaminants. The extent of volatilization of organic chemicals at The extent of volatilization of organic chemicals at waterfalls may be controlled by diffusion limitations (as is the case with oxygen and chemicals with large air/water partition coefficients), by the flow rate of air into the plunge pool (for chemicals with low air/water partition coefficients), or both. A model is applied to 11 organic contaminants present in the water of Niagara Falls. The results suggest that volatilization is significant for chloroform, chlorinated benzenes, and polychlorinated biphenyls, but negligible for 2,3,7,8-tetrachlorodienzo-p-dioxin, lindane, and polychlorinated aromatic hydrocarbons. The model can generate only order-of-magnitude estimates. Model validation is required for more exact predictions. (Author's abrequired for more exact predictions. (Author's abstract) W90-06994

DISSOLVED ARSENIC SPECIES IN THE SCHELDE ESTUARY AND WATERSHED, BELGIUM.

Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

Sistry. M. O. Andreae, and T. W. Andreae. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 29, No. 5, p 421-433, November 1989. 6 fig. 1

Descriptors: *Arsenic, *Belgium, *Estuaries, *Path of pollutants, Industrial wastes, Model studies, Oxidation-reduction potential, Oxygen depletion, Tributaries, Watersheds.

The Schelde watershed drains a densely populated and industrialized region in central Europe. The Zenne River, a tributary which flows through the center of Brussels industrial region, contributes most of the arsenic to the river-estuary system. Inputs of industrial and domestic effluents create a Inputs of industrial and domestic effluents create a region of anoxic conditions in the water column of the upper estuary. A study of arsenic concentrations and speciation in the rivers of the Schelde watershed shows that the ratio of As(III) to As(V) is elevated in the anoxic part of the estuary and those tributaries that are depleted in oxygen. The combination of a near-constant anthropogenic arsenic emission and seasonally fluctuating water discharge creates a variable arsenic concentration in the river endmember. This variability can exin the river endmember. This variability can ex-plain the non-linearity in the arsenic-salinity relaplant the non-incentry in the assence-saminy teat-tionship in the estuary, where a pronounced ar-senic maximum is seen in a region without local arsenic sources. The As(III)/As(V) ratio in the estuary has typical marine values in the lower estuary and increases sharply at the oxic/anoxic interface near the head of the estuary. A numerical model, incorporating fluctuating river composition model, incorporating fluctuating river composition and discharge tidal mixing, zero-order reduction of arsenate, and first-order oxidation of arsenite was atsenate, and instructed conduction of arsenite was tested to model the distribution and redox specia-tion of arsenic in the estuary under non-steady-state conditions. It is concluded that the limited data set available does not make it possible to rigorously verify the applicability of the model or the uniqueness of the solutions obtained. Further the uniqueness of the solutions obtained. Further profiles measured under different flow conditions will be required before it can be considered that the major features of the biogeochemical arsenic cycle in the Scheide estuary have been conclusively established. However, the proposed model can serve as a useful tool in the interpretation of the distribution and speciation behavior of an element is the extraction of the contraction of the distribution and speciation behavior of an element. ustriouton and speciation behavior of an element in the estuarine environment, when both the com-position of the river endmember and the river discharge are allowed to fluctuate in a non-analyti-cal fashion. (Friedmann-PTT)

OCCURRENCE AND DISTRIBUTION OF PO-LYCYCLIC AROMATIC HYDROCARBONS IN SURFACE SEDIMENTS AND WATER FROM THE BRISBANE RIVER ESTUARY, AUSTRA-

Griffith Univ., Nathan (Australia), School of Aus-

Griffin Only, Nathan (Australia). School of Australian Environmental Studies. S. I. Kayal, and D. W. Connell. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 29, No. 5, p 473-487, November 1989. 2 fig. 5 tab. 42 ref

Descriptors: *Australia, *Brisbane River Estuary, *Estuarine sediments, *Path of pollutants, *Polycyclic aromatic hydrocarbons, Bottom sediments, Distribution patterns, Estuaries, Gas chromatography, Hydrocarbons, Mass spectrometry, Organic compounds, Particulate matter, Pollutant identification, Sediment contamination, Suspended load.

Twenty-three composite sediment and eight water particulate and water filtrate samples were collected along with Brisbane River estuary from the mouth to 40 km upstream. The polycyclic aromatic hydrocarbons in the samples were isolated by solvent extraction and column chromatography then identified and quantified by gas chromatography then identified and quantified by gas chromatography and gas chromatography coupled with mass spectrometry. A total of 72 polycyclic aromatic hydrocarbons were identified in the samples with fluoranthene and pyrene occurring in the highest concentrations, up to 2.34 +/-1.73 and 2.26 +/-1.72 micrograms/g, respectively, in sediments. Total polycyclic aromatic hydrocarbon distribution patterns showed that the most urbanized zone Total polycyclic aromatic hydrocarbon distribu-tion patterns showed that the most urbanized zone of the study area had the highest total polycyclic aromatic hydrocarbon concentration (16.1 micro-grams/g). Concentrations were relatively lower both upstream and downstream from this area. Upstream there were no significant inputs but downstream various industries constituted major point sources; however, the concentrations were comparatively low, probably due to flushing by tides and currents. Distribution of polycyclic aro-matic hydrocarbons were not significantly influmatic hydrocarbons were not significantly influ-enced by the organic carbon content and particle size composition of sediments. Polycyclic aromatic hydrocarbon assemblages observed in the samples were relatively rich in hydrocarbons having pyrolytic origins. However, the presence of petroleum derived components was also indicated by several characteristic component composition ratios. (Author's abstract) W90-07005

TRANSPORT OF CARBON, NITROGEN AND PHOSPHORUS IN A BRITTANY RIVER,

FRANCE. Universite de Bretagne-Occidentale.

Oniversité de Bretagne-Occidentaie, Brest (France). Station Biologique. M. V. M. Wafar, P. le Corre, and J. L. Birrien. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 29, No. 5, p 489-500, November 1989. 6 fig. 1 tab. 32 ref.

Descriptors: *Carbon, *France, *Nitrogen, *Nutrient transport, *Path of pollutants, *Phosphorus, *Stream pollution, Ammonium, Cycling nutrients, Estuaries, Fate of pollutants, Fertilizers, Flushing, Nitrates, Nutrients, Organic compounds, Phosphotos Privates phates, Rivers.

Concentrations of NO3(-), NO2(-), NH4(+), PO4(3-), Si(OH)4(-), dissolved and particulate organic carbon, nitrogen and phosphorus, chlorophyll a, phaeopigments, carbohydrates and propnyll a, phaeopigments, carbonydrates and pro-teins were measured for one year in the Morlaix River waters (Brittany coast, France). By compari-son with the averages known for the unpolluted rivers of the world, concentrations of NO3(-), NH4(+), PO4(3-), NO2(-) and dissolved organic nitrogen are found to be much higher, and those of nitrate and ammonium exceed even those known for highly polluted rivers. The selective pollution by N compounds is caused by an excessive use of fertilizers in the hinterland although with NH4(+), urban pollution can also be an important factor. Allochthonous sources supply a major fraction of particulate organic compounds to the river waters. Dissolved fractions of N and P in river waters are very large compared to the particulate fractions, whereas carbon is more or less equally distributed between dissolved and particulate organic carbon. Transport of these nutrients to the estuary show three different patterns in relation to river dis-charge changes. Areal loading of the estuary with NO3(-) and NH4(+) is greater than that known for

other temperate estuaries. The deleterious effects of N pollution are, however, offset by the low freshwater flow, high tidal prism volume, estuarine basin geomorphology and uptake by benthic microalgae. (Author's abstract) W90-07006

LABORATORY AND NUMERICAL INVESTI-GATION OF SOLUTE TRANSPORT IN DIS-CONTINUOUS FRACTURE SYSTEMS. Newfoundland Dept. of Environment and Lands,

J. W. Robinson, and J. E. Gale. Ground Water GRWAAP, Vol. 28, No. 1, p 25-36, January/February 1990. 19 fig, 3 tab, 17 ref.

Descriptors: *Fracture permeability, *Groundwater movement, *Hydrologic models, *Model studies, *Path of pollutants, *Solute transport, Geohydrology, Geologic fractures, Hydrologic properties, Mathematical models, Mixing, Physical models, Simulation, Vertical flow.

Mixing of fluids at fracture intersections was examined using both a series of plexiglas models and a two-dimensional, finite-element, discrete fracture model. The physical laboratory models included 12 models having two continuous, fully intersecting fractures with different intersection angles and apertures, a single model consisting of a single continuous fracture offsetting a second fracture, and a fracture system model consisting of parallel fractures in two intersecting sets. The plexiglass model results indicated essentially no mixing occurred in the fully intersecting fracture models when the apertures were equal. Mixing was found to be dependent only upon the relative size of the inlet and outlet fractures even with multiple intersections. For transport of a conservative solute in a and outer fractures even win multiple micrisec-tions. For transport of a conservative solute in a discontinuous, random, discrete fracture system, the numerical model used the mixing algorithm for fracture intersections, developed from the physical fracture intersections, developed from the physical model study. At each four-way intersection, a novel approach was used to uncouple and recouple the nodal points to ensure the proper assignment of concentrations to each fracture element. Using the laboratory-determined mixing algorithm, the numerical model demonstrated that more longitudinal and less lateral dispersion takes place than when complete mixing at fracture intersections is nal and less lateral dispersion takes place than when complete mixing at fracture intersections is assumed. In addition, more longitudinal transport takes place in discontinuous than in continuous fracture systems. These findings indicate that contaminants migrating through fractured media, where the fracture walls are not in contact, will not be dispersed and diluted to the extent that previous numerical models have predicted; hence, the contaminant will be discharged to the biosphere in much greater concentration than expected. (Author's abstract) W90-07012

SIMULATED EFFECTS OF QUARRY DEWA-TERING NEAR A MUNICIPAL WELL FIELD. Geological Survey, Columbus, OH. For primary bibliographic entry see Field 2F. For primary W90-07013

VOLUME ESTIMATION OF LIGHT NONA-OUEOUS PHASE LIQUIDS IN POROUS

Kennedy/Jenks/Chilton, Inc., San Francisco, CA. A. M. Farr, R. J. Houghtalen, and D. B. A. M. Farr, r McWhorter.

Ground Water GRWAAP, Vol. 28, No. 1, p 48-56, January/February 1990. 8 fig, 4 tab, 10 ref.

Descriptors: *Groundwater pollution, *Hydrologic models, *Interstitial water, *Light nonaqueous phase liquids, *Path of pollutants, *Porous media, *Soil contamination, *Vadose water, *Volumetric analysis, *Water level, *Water table, Capillary water, Estimating, Hydrologic properties, Monitoring

An analytic method is presented for estimating the volume of mobile Light Nonaqueous Phase Liquids (LNAPL) in porous media from observed LNAPL thicknesses in monitoring wells. Static

Group 5B-Sources Of Pollution

(mechanical) equilibrium of fluids in a homogene-ous porous medium is the key condition on which the method is based. Both the Brooks-Corey and van Genuchten equations, with parameters derived from laboratory column experiments reported in from laboratory column experiments reported in the literature, are used to relate fluid contents to capillary pressures. The calculations show that LNAPL in the vadose zone does not distribute itself as a distinct layer floating on the top of a capillary fringe. Rather, the traditional concept of a capillary fringe is not applicable when LNAPL is present. Further, neither the LNAPL level nor the water level in monitoring walk is equal to the water level in monitoring wells is equal to the water-table elevation. The water table, being the water-table elevation. The water table, ceing the surface on which the water pressure is zero gage, is located above the LNAPL water interfaced in the well, and LNAPL in the porous media will reside below the water table. It is shown that finite volumes of LNAPL theoretically can exist in mavolumes of LivarL theoretically call exist in ma-terials with positive entry pressures (e.g., Brooks-Corey porous media) without revealing their pres-ence in the form of an LNAPL layer in monitoring wells. However, LNAPL in porous media with zero entry pressure will always appear in monitor-ing wells, regardless of the volume of LNAPL in the porous medium. Only in porous media with very uniform pore sizes is the volume of LNAPL in the vadose zone approximately proportional to the thickness of LNAPL in monitoring wells. (Author's abstract) W90-07014

ESTIMATION OF FREE HYDROCARBON VOLUME FROM FLUID LEVELS IN MONI-TORING WELLS.

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.

R. J. Lenhard, and J. C. Parker.

Ground Water GRWAAP, Vol. 28, No. 1, p 57-67, January/February 1990. 4 fig. 2 tab. 18 ref, append. American Petroleum Institute Contract WM-5-324-7, EPA Agreement CR-814320.

Descriptors: *Groundwater pollution, *Hydrocarbons, *Monitoring wells, *Oil pollution, *Porous media, *Water table, Capillary water, Estimating, fluid mechanics, Groundwater level, Hydraulic properties, Interstitial water, Light nonaqueous phase liquids, Pressure distribution, Water pres-sure, Water table wells, Wells.

Under the assumption of local vertical equilibrium, fluid pressure distributions specified from well fluid levels in monitoring wells may be used to predict water and hydrocarbon saturation profiles predict water and hydrocarbon saturation profiles given expressions for air-water-hydrocarbon saturation-pressure relations. Vertical integration of the oil-saturation profile yields the actual oil volume in porous media per unit area adjacent to the well. Three-phase fluid distributions are predicted using a scaling procedure which requires knowledge of two phase air-water saturation-pressure relations, hydrocarbon density, and hydrocarbon surface tension. Airwater saturation-pressure bon surface tension. Air-water saturation-pressure relations are parameterized by either the Brooks-Corey or van Genuchten expressions. Parameters in the models are estimated from grain-size distribution data for two hypothetical soils. Results revealed that, whereas the distance above an oil-water table at which oil saturations become zero water table at which oil saturations become zero may be independent of soil type, estimated light nonaqueous phase liquid (LNAPL) volumes per unit area may differ substantially. Hence, estimates of LNAPL volume cannot be inferred directly from soil LNAPL thickness or well LNAPL from soil LNAPL thickness or well LNAPL thickness data without consideration of effects of soil properties. Furthermore, it is demonstrated that no simple linear conversion scheme can be employed to relate the height of LNAPL in a monitoring well to the LNAPL volume in porous media. It is also demonstrated that, whereas the distance show the oil water table of which editions the state of the control of the c media. It is also demonstrated that, whereas the distance above the oil-water table at which oil saturations become zero may be independent of soil type, estimated LNAPL volumes in different soils will vary substantially. Estimates of LNAPL volume cannot be inferred directly from soil LNAPL thickness or well LNAPL thickness data without consideration of effects of soil properties. (Author's abstract) W90-07015

COMPATIBLE SINGLE-PHASE/TWO-PHASE NUMERICAL MODEL: 1. MODELING THE TRANSIENT SALT-WATER/FRESHWATER INTERFACE MOTION.

Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information

Geologique.
E. Ledoux, S. Sauvagnac, and A. Rivera.
Ground Water GRWAAP, Vol. 28, No. 1, p 79-87, anuary/February 1990. 10 fig, 16 ref.

Descriptors: *Coastal aquifers, *Geohydrology, *Groundwater movement, *Hydrologic models, *Mathematical models, *Multiphase flow, *Path of pollutants, *Saline water intrusion, *Saline-freshwater interfaces, Finite difference methods, Groundwater, Mathematical studies, Model studies. Model testing

A numerical model (NEWVAR) to simulate the transient movement of a discrete interface between salt water and freshwater is presented. NEWVAR is designed to allow the analysis of a regional two-dimensional groundwater flow in coastal aquifers. The numerical solution permits the prediction of both regional freshwater levels and two-dimenboth regional freshwater levels and two-dimen-sional freshwater/salt-water interface by using nested square meshes. The numerical solution is based on the finite-difference method; the Gauss-Jordan direct method is used for solving steady-state and unsteady-state linear equations. Different procedures are used to avoid numerical difficulties in the transient position of the interface tow for two-dimensional areal flow. The numerical solu-tion was tested against the analytical ones for the cases of an advancing interface and of a floating freshwater lens over sea water. These tests showed good agreement, thus verifying the finite-difference approximation. (Author's abstract) W90-07017

CHEMISTRY OF STREAMS DRAINING GRASSLAND AND FOREST CATCHMENTS AT PLYNLIMON, MID-WALES. Institute of Terrestrial Ecology, Bangor (Wales).

Bangor Research Station.
For primary bibliographic entry see Field 2K.
W90-07024

CONTAMINATION OF RURAL PONDS WITH PESTICIDE, 1971-85, ONTARIO, CANADA. Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab. R. Frank, H. E. Braun, B. D. Ripley, and B. S.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 401-409, March 1990. 4 tab, 18 ref.

Descriptors: *Canada, *Farm ponds, *Herbicides, *Pesticides, *Triazine pesticides, *Water pollution sources, Agricultural chemicals, Data collections, Path of pollutants, Ponds, Rural areas, Sediment analysis, Spills.

When applying pesticides to their crops Ontario farmers use water as the major diluent and carrier. Owners of rural ponds contacted the Ministries of Agriculture and Food or Environment when water Agriculture and Food or Environment when water supplies were suspected of being contaminated and requested pesticide analysis. Between 1971 and 1985, water samples from 211 rural ponds were analyzed for pesticides. Contamination was found in 132 or 63% of the ponds. The greatest number of contaminations were associated with treated of contaminations were associated with treated confining were associated with treatment corn fields or rotational crops including corn (76 contaminated ponds); adjacency to sprayed crops was also a major factor (102 out of 168 ponds contaminated). Ninety-three or 70% of the 132 contaminated). Ninety-three or 70% of the 132 contaminated ponds contained a single pesticide, and in 84 ponds herbicides were found. Triazine herbicides were suspected in 124 ponds and identified in 82 (66%). The highest concentrations were the results of accidental spills (16 ponds). Seven ponds had combined residues of herbicides over 200 micrograms/L and 13 ponds had residues of 20 to 200 micrograms/L. Twenty-two different herbicides, one fungicide and six different insecticides were identified in pond water. In several of the ponds, the sediment was analyzed and found to contain residues many times higher in concentra-

tion than the water. Three ponds had atrazine residues of between 0.7 and 8.9 micrograms/L. Residues of chlorophenoxy, chlorobenzoic and chloropicolinic acid herbicides injuriously affected seedling crop plants raised in greenhouses when seedling crop plants raised in greenhouses when water was used from these contaminated ponds. (VerNooy-PTT) W90-07027

SURVEY OF FARM WELLS FOR PESTICIDES, ONTARIO, CANADA, 1986 AND 1987.

Ontario Ministry of Agriculture and Food, Guelph (Ontario). Agricultural Lab. Services Branch. R. Frank, H. E. Braun, B. S. Clegg, B. D. Ripley, and R. Johnson.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 410-419, March 1990. 5 tab, 16 ref.

Descriptors: *Canada, *Groundwater pollution, *Herbicides, *Pesticides, *Water pollution sources, *Wells, Agricultural chemicals, Atrazine, Data collections, Farms, Leaching, Metolachlor, Path of pollutants, Spills, Surface runoff.

A study was conducted in 1984 on wells of cash-crop farms located on mineral soils across Southern Ontario; the present study of 179 wells is an extension of the 1981-84 study. In 1986 and 1987, 103 and 76 wells, respectively, were sampled by cooperators across Ontario. Results of water analycooperators across Ontario. Results of water analyses revealed that in 1986 10 wells contained residues of pesticides and in 1987 that number was four. These 4 wells contained 43, 0.9, 0.8 micrograms/L, and no detectable metolachlor, and 52, 1.4, 0.8 and 0.7 micrograms/L atrazine. Levels of atrazine and its metabolite desethyl atrazine appeared in 9 of the 10 wells in 1986. Of the 10 wells found to contain atrazine and one well with materials. found to contain atrazine and one well with meto-lachlor, the only known means of entry was laction, the only known means of entry was through leaching down the profile or from surface runoff water entering directly into the well. The most probable leading causes of well contamina-tion were due to either back-siphoning, overfilling the pesticide spray tank, spilling of concentrate, or washing equipment too close to the well. The incidences of contamination appear to have de-clined, but the levels of contamination do not appear to have changed. (VerNooy-PTT) W90-07028

LEVELS OF HEAVY METALS AND ORGAN-OCHLORINE PESTICIDES OF CYPRINID FISH REARED FOUR YEARS IN A WASTEWATER TREATMENT POND. 'Adour-Garonne' Water Authority, 90 rue du Fer-

etra, 31078 Toulouse, France. F. Guerrin, V. Burgat-Sacaze, and P. de Saqui-

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 461-467, March 1990. 1 fig, 5 tab, 22 ref.

Descriptors: *Aquaculture, *Bioaccumulation, *Carp, *Chlorinated hydrocarbons, *Heavy metals, *Pesticides, *Wastewater lagoons, Animal tissues, Bioassay, Cadmium, Lead, Mercury, Path of pollutants, Population exposure, Sediment analysis, Tissue analysis, Water pollution effects.

A study was made on a sample of 14 tench (Tinca tinca) and 4 rudd (Scardinius erythrophthalmus), introduced 4 years before in a wastewater treatment pond of the town of Realmont, France. Both ment pond of the fown of Realmont, France. Both species may be considered as good subjects for pesticide contamination, since tench is a bottom feeder, and rudd feeds mainly on plankton and benthos. Cadmium (Cd), lead (Pb) and mercury (Hg) levels in the sediments varied from less than 1 to 4.0, 46.0 to 248.0, and less than 0.05 to 1.35 to 4.0, 46.0 to 248.0, and less than 0.05 to 1.35 micrograms/g dry weight, respectively. Only Pb (0.2 to 0.3 micrograms/L) was detected in the water. Cadmium levels in rudd liver, kidney and muscle tissues were 0.056, 0.157, and < 0.01 micrograms/g, respectively. Similar values for tench were 0.058, 0.149, and < 0.01 micrograms/g. Pb (< 0.10 micrograms/g) and Hg (< 0.01 micrograms/g) were not detected in liver or kidney tissues of either species. Upon analysis for organochlorine pesticides, total levels of HCH (hexach-

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lorocyclohexane) and HCB (hexachlorobenzene) in the liver of tench were 0.110 and 0.014 micrograms/g, respectively. Fish with these levels of Cd, Pb, Hg, and organochlorine pesticides are still fit for human consumption. However, careful fit for human consumption. However, careful thought should be given to the use of wastewater ponds for aquaculture, since concentrations of micro-pollutants in sewage varies greatly. (Ver-Nooy-PTT) W90-07035

UPTAKE OF LEAD, CHROMIUM, CADMIUM AND COBALT BY CLADOPHORA GLOMERATA.

Vyzkumny Usta (Czechoslovakia). Ustav Vodohosnodarsky, Prague

(CZECHOSIOVAKIA).

J. Vymazal.

Bulletin of Environmental Contamination and
Toxicology BECTA6, Vol. 44, No. 3, p 468-472,
March 1990. 1 tab, 16 ref.

Descriptors: *Algae, *Bioaccumulation, *Cadmi-um, *Chromium, *Cladophora, *Cobalt, *Lead, *Path of pollutants, Bioassay, Heavy metals, Plant tissues, Tissue analysis, Trace metals.

tissues, Tissue analysis, Trace metals.

The time-course of uptake of lead (Pb), chromium (Cr), cadmium (Cd), and cobalt (Co) by cladophora glomerata (L.) Kutz, a common filamentous green alga in freshwater, was studied. Uptake experiments (15 replicates for each metal) were conducted by placing the alga into 400 ml of test medium (200 micrograms/L metal in solution) for 6 hours, with sampling after 0.25, 0.5, 1, 2, 4, and 6 hours. Short term uptake of the trace metals differed in both rate of uptake and maximum concentration obtained. The metal concentration in Cladophora after 6 hours were 168 micrograms/g Co. The most rapid uptake appeared with Cr (120.7 micrograms/g) after 15 minutes of exposure, i.e, 71.8% of Cr available). Initial rate of lead uptake was also rapid (60.5 micrograms/g after 15 minutes), but substantial uptake continued to occur for 2 hours. The uptake rate of Cd was initially slower than that of Cr or Pb (16.8 micrograms/g after 15 minutes), but cell concentrations continued to increase during the first 4 hours of exposure. (Ver-Nooy-PTT) Nooy-PTT) W90-07036

HEAVY METAL CONCENTRATIONS IN THE BANANA PRAWN, PENAEUS MERGUIENSIS, AND LEADER PRAWN, P. MONODON, IN THE TOWNSVILLE REGION OF AUSTRALIA. James Cook Univ. of North Queensland, Towns-ville (Australia). Graduate School of Tropical Vet-

ville (Austraina). Uraduate School of Tropical Veterinary Science.

D. Darmono, and G. R. W. Denton.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 479-486, March 1990. 2 tab, 15 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Path of pollutants, *Shellfish farming, *Shrimp, *Stream pollution, *Trace metals, Animal tissues, Australia, Hepatopancreas, Muscle, Population exposure, Tissue analysis, Water pollution effects.

e survey was undertaken to establish the A baseline survey was undertaken to establish the range of metal levels in field populations of juvenile banana prawns (Penaeus merguiensis) and farmed stocks of juvenile leader prawn, P. monodon. Concentrations of trace elements, i.e., copper (Cu), zinc (Zn), iron (Fe), manganese (Mn), cadmium (Cd), silver (Ag), magnesium (Mg), lead (Pb), nickel (Ni), cobalt (Co) and mercury (Hg), were determined in wild and farmed prawn stocks and a preliminary assessment of inter-element relationships within tissues was also made. Wild juvenile banana prawns were collected in 1986 from the estuaries of Three Mile Creek near Townsville, Australia. Compared with the other tissues examestuaries of Three Mile Creek near Townsville, Australia. Compared with the other tissues examined, muscle of both species of prawns contained the lowest levels of Zn, Cu, Fe, and Mn. Zinc was always the most abundant element (12.60 in muscle (wild) to 58.16 micrograms/g in hepatopancreas (aquaculture) closely followed by copper (7.23 in muscle (aquaculture) to 199.10 in hepatopancreas (wild)). Manganese preceded Fe in order of abundance in P. merguiensis while the reverse was

shown for cultured P. monodon. In both species Hg was the least abundant element detected, while concentrations of Ag, Ni, Pb, Cd, and Co were consistently below the limits of analytical detection (< 0.5 to 0.7 micrograms/g). Metal concentration data from the two collection sites were compared with data from other crustacean studies. In this study, consistent correlations between metal pairs were only evident for Mn:Cu and Mn:Ag. Both were only evident for min-rel and min-rel both relationships were negative, suggesting competi-tion between these elements for ligands. Concen-trations of selected heavy metals in prawns from three different locations were indicative of a relathree different locations were indicative of a relatively clean coastal environment when compared with reported values for locations where pollution was suspected. Levels of Zn, Cu, Hg, and Cd in the muscle were below the maximum levels set by the Council for Human Consumption. (VerNooy-PTT) W90-07038

METABOLITES OF THREE STRUCTURAL ISOMERS OF BUTYLBENZENE IN THE BILE OF RAINBOW TROUT. Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch. H. Hellou, A. Ryan, and H. J. Hodder. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 487-493, March 1990. 1 tab, 14 ref.

Descriptors: *Benzenes, *Bile, *Butylbenzene, *Fate of pollutants, *Metabolites, *Molecular structure, *Trout, Bioassay, Fish, Gall bladder, Hydrocarbons, Metabolism, Path of pollutants.

In an ongoing study of the fate of petroleum hydrocarbons in fish, petroleum derived metabolites which concentrate in the gall bladder bile of rainbow trout (Salmo gairdneri) have been examined. The metabolism of three structural isomers of butylbenzene, n-butylbenzene sec-butylbenzene and tert-butylbenzene, in rainbow trout is reported. These compounds were chosen because several isomers of C-4 benzene were detected in analysis of No. 2 fuel oil. Groups of 10 to 12 trout were intubed through the mouth with 0.5 ml of a 5% intubed through the mouth with 0.5 ml of a 5% solution of one of the butylbenzenes in olive oil; 0.5% and 0.1% sec-butylbenzene solutions were also utilized. After 120 hours the fish were killed and their gall bladder bile analyzed for the type of glucuronides formed. Three alcohols were identified. The major sec-butylbenzene and n-butyl metabolites were identified as the tertiary alcohol, 2-penyl-2-butanol and 1-phenyl-1-butanol, respectively. When the concentration of the solution of 5 sec-butylbenzene in olive oil was reduced from 5 sec-butylbenzene in olive oil was reduced from 5 sec-butylbenzene in olive oil was reduced from 5 to 0.5% (by a factor of ten), the concentration of the metabolites was reduced by about a factor of four. When trout were exposed to tert-butyl benzene, five new peaks were detected by gas-liquid chromatography. The major metabolite was a monohydroxylated derivative of tert-butyl benzene. Results indicate that upon exposure of trout to three aromatic hydrocarbons of the same molecwhere aromatic nyurocaroons of the same molecular weight, ring structure, and with a single side chain, oxidation of the side chain will take place preferentially to that of the ring. (VerNooy-PTT) W90-07039

EFFECT OF HYDROMETEOROLOGICAL FACTORS ON SPREADING OF OIL PRODUCTS IN RESERVOIRS.

A. I. Al'khimenko. Hydrotechnical Construction HYCOAR, Vol. 23, No. 4, p 199-204, 1990. 2 fig, 2 tab, 6 ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 28-32, April, 1989.

Descriptors: *Hydrometeorology, *Oil pollution, *Oil slicks, *Path of pollutants, *Reservoirs, *Water pollution, Gasoline, Mathematical models, Model studies, Oil spills, Oil-water interfaces, On-site data collections, Vertical distribution, Water currents, Wave action, Wind.

To provide adequate reservoir water quality it is necessary to design the reservoir with consider-ation of background pollution and anthropogenic loads, and to routinely monitor and evaluate the degree of pollution by oil products and minimize

the consequences of oil spills in reservoir waters. Serious problems arise arise when solving these problems due to neglect of hydrometerological factors on the spreading of oil products in water areas. A model was developed for the effect of wind, waves, and currents with the Fay model, using data from wind and water conditions in marine environments. The formation and development of Langmuir circulations, an important factor in the spread of oil in water, is described by a system of equations. On site data collected in the Gulf of Finland in the Baltic Sea was used, as well Guil of Finland in the Battic Sea was used, as well as laboratory investigations. Experiments were conducted to determine the effect of waves on a film of motor oil, diesel fuel, and gasoline. Results made it possible to obtain the dependence of vertical distribution of the size of droplets on thickness of the initial film, there of oil products and wave. of the initial film, type of oil product, and wave steepness. Programs were developed to enable computer calculation of the spread of oil products in reservoirs under the effect of wind, waves, and currents. The effect of an ice cover was calculated by means of nomograms based on 7 years of on-site investigation in the Gulf of Finland, the Shelon River, and in Neva Bay. Tables are included in the paper for estimating the degree of pollution of a water area both by means of remote-sensing methods and visual observations. (VerNooy-PTT)

DETERMINATION OF IN SITU METAL PAR-TITIONING BETWEEN PARTICULATE MATTER AND GROUNDWATER.

Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.

M. C. Wells, M. Magaritz, A. J. Amiel, B. Rophe, and D. Ronen.

Naturwissenschaften NATWAY, Vol. 76, No. 12, p 568-570, December 1989. 5 fig, 16 ref.

Descriptors: *Chemical analysis, *Groundwater pollution, *Metals, *Particulate matter, *Path of pollutants, Adsorption, Aluminum, Aquifers, Cad-mium, Copper, Effluents, Fate of pollutants, Groundwater chemistry, Iron, Israel, Lead, Spatial distribution, Water sampling, Zinc.

Mobile particulate matter in groundwater is the main carrier of transition metals in aquifers. A multi-layer sampler was used to collect ground-water and particulate matter from an aquifer con-taminated by industrial effluents. Samples were collected from an observation well drilled into the Eocene chalk aquifer of southern Israel. Particu-Education of the transfer of t Zn in all fractions, and Ag in the oxide fraction. Aluminum noticeably increases with depth for the oxide fraction. Profiles of dissolved metals in groundwater show that metals are distributed ho-mogeneously downwell for Ag, Cu and Fe, but surface-enriched for Al, Cd, and Zn. Results imply surface-enriched for Al, Cd, and Zn. Results imply that Cu and Pb are transported through the unsaturated zone adsorbed on particulate matter, and upon arrival at the water table are subsequently released into groundwater. In the studied samples, carbonate averaged 15% of the bulk solid, oxides and organics both amounted to < 1.5%, and most of the remainder was fine crystalline quartz. This indicates that large amounts of potentially labile and toxic metals in the environment are partitioned into a very small part of the particulate phase. (VerNooy-PTT) W90-07051

TRIBUTYLTIN AND TOTAL TIN IN MARINE SEDIMENTS: PROFILES AND THE APPARENT RATE OF TBT DEGRADATION.

Auckland Univ. (New Zealand). Dept. of Zoolo-

gy. S. J. de Mora, N. G. King, and M. C. Miller. Environmental Technology Letters ETLEDB, Vol. 10, No. 10, p 901-908, October 1989. 2 fig, 2

Group 5B-Sources Of Pollution

Descriptors: *Antifoulants, *Degradation, *Estuarine sediments, *Fate of pollutants, *Organotin compounds, *Path of pollutants, *Pesticides, *Tin, Marine pollution, New Zealand, Storm runoff.

Total tin and tributyltin (TBT) were measured in sediment cores collected from the Tamaki Estuary in Auckland, New Zealand. The total tin concentration ranged up to 6.2 micrograms/gram and the TBT concentration ranged up to 0.759 micrograms TBT-Sn/gram. While the maximum total tin values were observed adjacent to a storm water outfall, the highest surficial TBT levels were observed in the nignest surricial IBI levels were observed in the vicinity of boat washdown and painting yards. TBT concentrations decreased with depth in the sediments. The degradation rate for TBT in sedi-ments exhibited first order kinetics, with a rate constant of 0.375/y. TBT had a half-life of 1.85 years in the sediment. (Author's abstract) W90-07054

SPARTINA ALTERNIFLORA AS A POTENTIAL SOURCE OF HEAVY METALS TO THE FOOD CHAIN OF THE SEPETIBA BAY, RIO

DE JANIERO, BRAZIL. Universidade Federal de Sao Carlos (Brazil). Dept.

de Ciencias Biologicas. N. R. W. Lima, W. C. Pfeiffer, and M. Fiszman. Environmental Technology Letters ETLEDB, Vol. 10, No. 10, p 909-920, October 1989. 1 fig, 6

Descriptors: *Bays, *Brazil, *Food chains, *Heavy metals, *Path of pollutants, *Salt marshes, *Spartina, Aquatic plants, Aquatic productivity, Bioavailability, Biomass, Industrial wastes, Litter, Marsh plants, Plant tissues, Rio de Janeiro, Sepetible Bair.

Spartina alterniflora growing in Sepetiba Bay were investigated for their ability to take up Zn, Cd, Cr, Mn, and Fe from sediments and their subsequent potential availability to the food chains of the bay through litter. Zn, Cd, and Cr in sediments were highest in Coroa Grande and confirm that this is an area highly influenced by anthropogenic releases. When comparing the two marshes, the mean metal when comparing the two marshes, the mean metal mass per square meter in grass tissues found in Pedra de Guaratiba were higher than Coroa Grande. In the litter these values were quite similar and were potentially available, mainly in summer and fall when the grass reaches its peak of productivity. (Author's abstract) W90-07055

SEASONAL VARIATION OF CERTAIN OXI-DATION-REDUCTION CHARACTERISTICS OF THE RIVER BHAGIRATHI (INDIA). Garhwal Univ., Srinagar (India). Dept. of Zoolo-

gy. A. Gautam, H. R. Singh, and O. P. Sati. Proceedings of the Indian National Science Academy NSBGAM, Vol. 55B, No. 2, p 111-114, April 1989. 2 fig, 1 tab, 11 ref.

Descriptors: *Biochemical oxygen demand, *India, *Oxidation-reduction potential, *Rivers, *Water pollution effects, *Water quality, Bhagirathi River, Hydrogen ion concentration, Oxidation-reduction index, Seasonal variation.

The Bhagirathi River was examined for oxidation-reduction potential (Eh), oxidation-reduction index, pH, and biochemical oxygen demand (BOD). Three stretches were sampled. A continuous decrease in the Eh and oxidation-reduction index was observed from the upper to the lower stretch, indicating a continuous addition of biodegradable material throughout the year. The increasing pH and BOD values from the upper to creasing pH and BOD values from the upper to lower stretch also support this indication. Higher amounts of organic material in the river during winter were shown by the low Eh and oxidation-reduction index and high pH and BOD values. (Miller-PTT) W90-07058

ETHYLENE DIBROMIDE: PERSISTENCE IN SOIL AND UPTAKE BY PLANTS.

Connecticut Agricultural Experiment Station,

New Haven. Dept. of Soil and Water. C. R. Frink, and G. J. Bugbee. Soil Science SOSCAK, Vol. 148, No. 4, p 303-307, October 1989. 2 fig, 14 ref.

Descriptors: *Absorption, *Ethylene dibromide, *Fumigants, *Halogenated pesticides, *Path of pol-lutants, *Soil contamination, *Soil-water-plant re-lationships, Dose-response relationships, Organic compounds, Pesticides.

Ethylene dibromide (EDB, or 1,2-dibromoethane) Ethylene dibromide (EDB, or 1,2-dibromoethane) was used in the United States as a soil fumigant from 1948 until 1983, when its discovery in stored grain and in wells prompted the EPA to ban further agricultural uses. Traces of EDB have also been found in some Connecticut soils up to 25 yr after their last known fumigation. This persistence in soil and water raised concern over possible contamination of vegetables or lawn grasses plant-ed in soil previously treated with EDB. To simued in soil previously treated with EDB. To simulate a worst case, radishes (Raphanus sativas L. cv. Champion) and perennial rye grass (Lolium perenne cv. Pennfine) were planted within 7 d after fumigation, rather than waiting the usual 4 to 6 wk for the EDB to dissipate. Successive harvests during the first growing season showed that the concentrations of EDB in the tissue decreased relative to the concentrations in the soil. No EDB was taken up by radishes or grass in the second growing season after fumigation, although residues of EDB that were resistant to extraction with hexane persisted in the soil and could be removed only with hot methanol. These experiments show that the traces of EDB found to persist in soil for only with not methanol. These experiments show that the traces of EDB found to persist in soil for many years after fumigation are not taken up by plants. Also, the linearity of the dose-response curves for uptake of organic compounds by plants assumed by EPA in its proposed regulations for land application of sewage sludge should be reex-amined. (Author's abstract) W90-07082

TRANSPORT OF NONSORBED CHEMICALS IN THE SUBSURFACE ENVIRONMENT: PROPOSED MODEL WITH EXPERIMENTAL VER-IFICATION.

Southern Univ., Baton Rouge, LA. Dept. of Civil

Formula of the Contract No. 1, 200 Science, S. F. Dietrich, J. P. Knezovich, and F. L. Harrison. Soil Science SOSCAK, Vol. 149, No. 1, p 23-34, January 1990. 13 fig, 1 tab, 33 ref, append. DOE Contract No W-7405-Eng-48.

Descriptors: *Groundwater movement, *Solute transport, Convection, Diffusion, Dispersion, Hy-drogen isotopes, Model studies, Path of pollutants, Radioactive tracers.

The objective of this research was to improve upon current models used to predict the transport of nonsorptive solutes in the subsurface environ-ment, since increased concern about soil and groundwater contamination has led to efforts to develop a better understanding and prediction of develop a better understanding and prediction or contaminant transport in soil systems. After sur-veying previous modeling efforts, including the convection and dispersion equations, the micro-pore-macropore model, and the mobile-immobile zone model, a model incorporating a modified mobile-immobile zone model is outlined. Some re-lationships are verified through experimental stud-ies, using tritisted, water are the tensor, in soluture ies using tritiated water as a tracer in columns packed with selected sorbents. In addition, the model was used to successfully predict the results of other experiments in which the flow rate and column height were changed. According to the model, molecules of nonsorptive chemicals are transported by convective and dispersive mechanisms in the mobile zones and by random molecular diffusion in the immobile zones, where molecules in general are considered to move either toward the soil surface or towards the mobile zones. The flow in these forward and backward zones. The flow in these forward and backward directions is a first-order process with two different rate constants. Also, partitioning of fluids between mobile and immobile zones is dependent on several variables, such as flow velocity, fluid viscosity, and soil-specific surface area. Although fitting individual breakthrough curves can be accomplished with other products the cutting model can plished with other models, the outlined model can

be used to predict the transport of nonsorptive solutes under a variety of experimental conditions. (Author's abstract)

MACROZOOBENTHOS IN THE RIVER TISZA AND ITS INFLUENTS.

Fisheries Research Inst., Szarvas (Hungary). For primary bibliographic entry see Field 5C. W90-07116

HEAVY METAL CONTENT IN THE BRAN-CHIAE OF SOME TISZA RIVER FISH.

Mid-Tisza Region Water Conservancy Director-ate, Szeged (Hungary). Water Chemistry Lab. F. Csepai, and J. Waijandt. TSCAB8, Vol. 23, p 97-105, 1989. 2 fig, 2 Tiscia

Descriptors: *Cadmium, *Fish, *Heavy metals, *Lead, *Mercury, *Path of pollutants, *Zinc, Fish food, Hungary, Tisza River.

The zinc, copper, lead and mercury content in the branchiae of 132 fish from 18 species in the Tisza River, Hungary, was examined using atomic absorption and microscopic histology method. Randomly caught fish were divided into five groups according to their trophic habits. The zinc, copper, according to their tropnic habits. The zinc, copper, lead, cadmium, and mercury concentrations in the branchiae exhibited a decreasing order from zinc to mercury. The examined metals, were not present in the branchiae at harmful levels. The metal concentration of the Tisza river is relatively low; it reaches neither the Hungarian, nor the international limits. Knowing the metal content in the branchiae and on the basis of data in literature, assumptions could be made on the quality of fish based on the requirements of metabolic hygiene and the metal ion concentration. (Author's abstract) W90-07117

INFLUENCE OF THE WASTE-WATER OF SZOLNOK ON THE WATER QUALITY OF THE TISZA RIVER.

Central Tisza_Region Environmental and Water

Conservancy Directorate, Szolnok (Hungary). J. Waijandt

Tiscia TSCAB8, Vol. 24, p 23-34, 1989. 4 fig, 3 tab,

Descriptors: *Food-processing wastes, *Hungary, *Path of pollutants, *Tisza River, *Wastewater pollution, *Water pollution effects, *Water pollution sources, *Water quality, Dissolved oxygen, Industrial wastewater, Municipal wastewater, Organic matter, Phosphates, Pollution load.

The reach of the river Tisza River between the mouth of the river Sajo and the town of Szolnok in Hungary can be characterized by an improvement of the water quality. In the middle reach of the Tisza a significant pollution load occurs only at Szolnok. In the vicinity of Szolnok the Tisza is being significantly loaded by the pollution coming from five industrial and four residential areas, which show considerable quantitative and qualititative variations in their wastewaters. Both their wastewaters. tative variations in their wastewaters. Both the output of the wastewater released and the load of output of the wastewater released and the load of certain polluting components showed a slight increase in the period between 1977 and 1987. Nearly half of the organic matter is being released into the Tisza by the Szolnok Sugar Works during sugar processing. The major part of the residential wastewater comes from detergents, fats, and oils. The deterioration in water quality is significant only during the sugar processing season from September to December, and has been studied in detail only for those periods. The deterioration of the only for those periods. The deterioration of the only for those periods. The deterioration of the water quality was clearly visible in comparative studies of the water in the reaches above and below Szolnok (Tiszaug) based on measurements of organic matter, dissolved oxygen and phosphate-ion concentration. The actual deterioration of water quality was less than would be expected. from calculations due to the self-purification of the river. For conservation of the water quality of the Tisza River, an adequate purification of the

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wastewater of the Szolnok Sugar Works is a necessary first step. (Author's abstract)

ACIDIC DEPOSITION: EXTENT AND IMPACT ON FOREST SOILS, NUTRITION, GROWTH AND DISEASE PHENOMENA IN CENTRAL EUROPE: A REVIEW.

Munich Univ. (Germany, F.R.). Dept. of Soil Sci-

K. E. Rehfuess

Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 1/2, p 1-20, October 1989. 4 fig, 2 tab, 79 ref.

Descriptors: *Acid rain effects, *Forest soils, *Groundwater pollution, *Soil properties, *West Germany, Aluminum, Forest ecosystems, Heavy metals, Leaching, Nitrates, Weather.

Present knowledge about the extent of acidic deposition in Central Europe is reviewed with special emphasis on the situation in West Germany, the relationships between soils and soil-mediated efrelationships between soils and soil-mediated effects of acidic deposition on the one hand and forest diseases on the other, and the temporal changes of relevant soil properties during the past decades. Infertile soils are more likely to act as regional or local than as widespread general stressors in forest ecosystems of West Germany. The more or less simultaneous outbreak of natural and of pollutant-determined diseases during the early eighties is postulated to be triggered by largescale weather stress, such as dry periods or frost phe-nomena. These weather stresses trigger natural dis-eases as well as regional tree decline determined by pollution and deposition. Infertile soils, inadequate nutrition, pollution and atmospheric deposition or pathogens are not general, but local/regional or disease type-specific stress factors wherever they act with intensity. Although these disease phenomena cannot be conclusively linked to atmospheric ena cannot be conclusively linked to atmospheric deposition, the high levels of hydrogen, nitrogen, and sulfur deposition can alter the chemical processes and functions of the soil over a long period of time. With high inputs of nitrogen and sulfur, the leaching of nitrates, alkaline metals, aluminum, and heavy metals is accelerated in a variety of soil types. The hydrosphere may be contaminated if these substances are passing the subsoil and parent rock, reaching the groundwater, the wells and the water courses. It is the prevention of these long term changes of soils and water bodies which regularly the property of the property of the property of the prevention of these long term changes of soils and water bodies which regularly the property of the prope term changes of soils and water bodies which urgently requires the control of the input of hydrogen, nitrogen, sulfur, and heavy metals to forest ecosystems and to cut down the emission of these compounds. (Brunone-PTT) W90-07123

EFFECTS OF ACID IRRIGATION AND LIMING IN A NORWAY SPRUCE STAND (PICEA ABIES (L.) KARST). Munich Univ. (Germany, F.R.). Dept. of Soil Sci-

K. Kreutzer, H. Reiter, R. Schierl, and A.

Gottlein.

Water, Air and Soil Pollution WAPLAC, Vol. 48,
No. 1/2, p 111-125, October 1989. 10 fig, 28 ref.

Descriptors: *Acid rain effects, *Forest soils, *Liming, *Soil contamination, *Spruce trees, *Water pollution sources, Aluminum, Calcium, Cation exchange, Hydrogen ion concentration, Ion mobilization, Magnesium, Nitrification.

Acid irrigation (pH 2.7-2.8) has caused significant changes in the chemistry of the soil of a mature Norway spruce (Picea abies) stand after 4 yr of Norway spruce (ricea aloess) stand atter 4 yr or treatment. In the surface humus layer, 20% of the exchangeable calcium, magnesium, potassium, and manganese ions were leached. This was connected with a decrease of pH and cation exchange capacity. In the mineral soil, no changes of pH and cation adsorption were observed. However, there cation assorption were observed. However, there was a significant increase of aluminum ions in the soil solution, exceeding 20 mg/L, mainly caused by dissolution of aluminum-hydroxides and aluminum-hydroxo-sulfates. The concentrations of minimum copper, zinc, and cadmium were nearly doubled. Manganese concentrations fluctuated according to periods with and without acid irrigation, showing reduction and oxidation phases. In contrast to

microorganisms, certain moss species and Oxalis acetosella, the mature spruce stand has not been severely damaged. Liming led to a significant increase of dissolved organic carbon, which is associated with mobilization of metals such as lead, copper, and aluminum in organic complexation. Also nitrification increased in the surface humus layer. As a consequence the nitrate concentrations Also nitrification increased in the surface humus layer. As a consequence the nitrate concentrations in the seepage water exceeded 250 mg/L. These findings suggest that good nutrient supply is of great importance for the trees to tolerate acidic impacts and increased aluminum concentration in the soil solution. The use of liming could be hazardous for water quality especially when lime is applied on lead or copper contaminated sites in the vicinity of streams. (Brunone-PTT) W90-07124

ALUMINUM TOXICITY IN FORESTS EX-POSED TO ACIDIC DEPOSITION: THE ALBIOS RESULTS.

Maine Univ., Orono. Dept. of Botany. C. S. Cronan, R. April, R. J. Bartlett, P. R. Bloom,

and C. T. Driscoll.
Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 1/2, p 181-192, October 1989. 3 fig, 2 tab, 37

Descriptors: *Acid rain effects, *Aluminum, *Forests, *Ion transport, *Sulfur deposition, *Toxicity, Europe, Forest watersheds, North America, Pine forests, Plant growth, Soil solution, Watershed

The ALBIOS project was conducted to examine the influence of acidic deposition on aluminum transport and toxicity in forested ecosystems of eastern North America and northern Europe. Patterns of aluminum chemistry were evaluated in 14 representative watersheds exposed to different levels of sulfur deposition. Controlled studies with solution and culture methods were used to test interspecific differences in aluminum sensitivity for one indicator species (honeylocust, Gleditisia tria-canthos L.) and six commercial tree species (red spruce, Picea rubens Sarg.; red oak, Quercus rubra; sugar maple, Acer saccharum; American beech, Fagus grandifolia; European beech, Fagus sylvatica; loblolly pine, Pinus taeda). Overall, red spruce tica; tolotily pine, Pinus taeda). Overail, red spruce was the tree species whose growth was most sensitive to soluble aluminum, with significant biomass reductions occurring at aluminum concentrations of approximately 200-250 micromoles per liter. American beech and loblolly pine appear to be the least likely of the species examined to be affected by known concentrations of soluble aluminum in natural forest stands. Analyses of soil solutions from the field sites indicated that the conditions for aluminum toxicity for some species exist at some of the study areas. At these watersheds, aluminum time study areas. At these watersheds, aluminum toxicity could act as a contributing stress factor affecting forest growth. (Author's abstract) (Brunone-PTT) W90-07125

MEASUREMENTS OF WET AND DRY DEPO-SITION IN A NORTHERN HARDWOOD FOREST.

FOREST.
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
J. P. Shepard, M. J. Mitchell, T. J. Scott, Y. M. Zhang, and D. J. Raynal.
Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 1/2, p 225-238, October 1989. 2 fig, 4 tab, 60

Descriptors: *Acid rain, *Atmospheric pollution, *Chemistry of precipitation, *Dry deposition, *Forest ecosystems, *ion transport, Mathematical models, Nutrient transport, Sulfates.

Inputs of wet and dry deposition were monitored at the Huntington Forest in the Adirondack Mountains of New York for two years in the open and beneath the canopy of a northern hardwood forest. In the open, ion flux estimates were similar using wet-only weekly (NADP protocol) and event collections, but bulk collections were higher for all ions except hydrogen ion, which was much lower.

These differences were due to the contribution of dry deposition and possible biotic alterations in

bulk collectors. Dry deposition was estimated using air concentrations and ion-specific deposi-tional velocities modeled with meteorological data, and contributed substantially to the input of all ions. Dry input of base cations was dominated by coarse particles, whereas gaseous inputs were more important for sulfur and nitrate ions. Atmospheric concentrations of sulfur dioxide and inputs of concentrations of satural understand in state of satural fate ions and hydrogen ions were lower at this site than sites closer to point sources of sulfur gas emission. The importance of estimating atmospheremission. The importance of estimating atmospheric inputs was examined using examples of elemental budgets. For example, different estimates of the contribution of dry deposition of sulfate ions resulted in conclusions ranging from no net retention to a net loss of this element. Such differences have important implications in assessing the current and future role of atmospheric inputs in affecting elemental cycling. (Author's abstract) W90-07126

ION LEACHING FROM A SUGAR MAPLE FOREST IN RESPONSE TO ACIDIC DEPOSI-TION AND NITRIFICATION.

Great Lakes Forestry Research Centre, Sault Sainte Marie (Ontario).

N. W. Foster, P. W. Hazlett, J. A. Nicolson, and I.

K. Morrison. Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 1/2, p 251-261, October 1989. 8 fig, 2 tab, 21

Descriptors: *Acid rain effects, *Forest ecosystems, *Forest soils, *Forest watersheds, *Ion leaching, *Leaching, *Maple trees, *Nitrification, *Soil solution, *Throughfall, Adirondack Mountains, Calcium, Magnesium, Mass balance, New York, Nitrates, Sulfates, Turkey Lakes Watershed.

Year-to-year variation in acidic deposition within a mature sugar maple-dominated forest and in leaching of ions from the associated podzolic soil were examined at the Turkey Lakes Watershed between 1981 and 1986. The contribution of atmospheric deposition to sulfate, nitrate and calcium ion leachdeposition to suirate, nitrate and calcium ion leaching decreased over the years. During the study period, the mean annual volume-weighted nitrate concentration decreased in throughfall and forest-floor percolate and increased in the mineral soil solution collected below the effective rooting zone. A substantial shift in the balance between zone. A substantial shift in the balance between sulfate and nitrate ion leaching from the mineral soil was observed; leaching of sulfate ions decreased and nitrate ions increased with time. Leaching of calcium and magnesium ions from the soil was increased as a result of excess nitrate ion production in the soil. The calculated output of nitrate ions from the soil considerably exceeded the atmospheric deposition of nitrate ions, whereas sulfate ion outputs were only moderately exceeded. the atmospheric deposition or intrate ions, whereas sulfate ion outputs were only moderately greater than inputs. The overall effect of the year-to-year changes in solution chemistry is to accelerate the acidification process, but the long-term consequences of the calcium losses are still largely unquences of the Calculm losses are sim largely un-known. Forest ecosystems can be expected to ex-hibit short-term adjustments to perturbations that disrupt their normal condition of a steady state (equilibrium) between inputs and outputs in any compartment of the ecosystem. (Author's abstract)

CYCLING OF MERCURY BETWEEN WATER, AIR, AND SOIL COMPARTMENTS OF THE ENVIRONMENT.

Atmospheric Environment Service, Downsview (Ontario).

W. H. Schroeder, J. Munthe, and O. Lindqvist. Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 3/4, p 337-347, November 1989. 4 fig, 2 tab, 62

Descriptors: *Fate of pollutants, *Geochemical cycles, *Mass balance, *Mercury, *Path of pollutants, *Volatilization, *Water pollution sources, Vapor pressure, Water solubility.

The behavior and ultimate fate of mercury intro-duced into the biosphere both from natural and from anthropogenic sources is of interest to many researchers. The propensity to resist chemical,

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photo-chemical or biological degradation processes, coupled with a high degree of mobility (due to favorable physicochemical properties such as relatively high vapor pressure and low solubility in water) bestows upon some chemical substances the necessary prerequisites for extensive recycling among environmental compartments. Certain inorganic and organometallic species of mercury exhib-it these characteristics. Field measurement data, collected in Canada and Sweden, provide informaconected in Canada and sweeter, provide informa-tion concerning the direction and magnitude of the material fluxes associated with transfer processes of mercury in the natural environment. The results of the field measurements point to the importance of the natural phenomena of emission or re-emis-sion involving the release of volatile mercury species from lake and soil surfaces into the overlying air, at least under warm weather conditions. Consequently, volatilization fluxes of mercury from natural surfaces should be taken into account when constructing biogeochemical cycles for this element and when calculating mass balances or budgets for mercury on local, regional, and global scales. (Author's abstract) cies from lake and soil surfaces into the overlying

SIMULATION OF THE LONG-TERM SOIL RESPONSE TO ACID DEPOSITION IN VARIOUS BUFFER RANGES.

OUS BUFFER RANGES.
Winard Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands).
W. DeVries, M. Posch, and J. Kamari.
Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 3/4, p 349-390, November 1989. 15 fig, 7 tab,

Descriptors: *Acid rain effects, *Atmospheric chemistry, *Buffer capacity, *Buffering, *Geo-chemical cycles, *Mathematical models, *Soil chemistry, *Soil water, Aluminum, Hydrogen ion concentration, Weathering.

A soil acidification model has been developed to A soil acidification model has been developed to estimate long-term chemical changes in soil and soil water in response to changes in atmospheric deposition. Its major outputs include base saturation, hydrogen ion concentration, and the molar aluminum/divalent base cation ratio (A/BC). Apart from net uptake and net immobilization of sittems that recovers executed for the restriction. nitrogen, the processes accounted for are restricted to geochemical interactions, including weathering of carbonates, silicates, and aluminum oxides and of carbonates, silicates, and aluminum oxides and hydroxides, cation exchange and carbon dioxide equilibriums. The behavior of the model was evaluated by analyzing the response of an initially calcareous soil of 50 cm depth to a constant high acid load over a period of 500 years. Results indicate a time lag of about 100 year for each percent calcium carbonate before the hydrogen ion con-centration begins to drop. In non-calcareous soils, the response mainly depends upon the initial amount of exchangeable base cations. The impact of various deposition scenarios on non-calcareous soils was analyzed for a time period of 100 years. The results indicate that the time lag between reductions in deposition and a decrease in the Al/BC ratio is short. (Author's abstract)

ACCUMULATION OF COPPER IN CLARIAS ANGUILLARIS L. AND OREOCHROMIS NI-LOTICUS L.
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of

Alinatu Beilo Oliv., Zaria (Nigeria). Dept. of Biological Sciences. J. A. Daramola, and A. A. Oladimeji. Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 3/4, p 457-461, November 1989. 2 tab, 13 ref.

Descriptors: *Bioaccumulation, *Bioassay, *Copper sulfate, *Fish physiology, *Path of pollutants, *Trace metals, Fish diets, Industral wastewater, Laboratory methods, Tissue analysis, Wastewater pollution.

Copper wastes from industrial discharge may be made available to aquatic organisms, particularly fish, and may be concentrated to harmful levels. Clarias anguillaris and Oreochromis niloticus were each exposed to solutions of Analar grade copper sulfate in static bioassays at a temperature range of 20 to 23.5 C and calcium carbonate hardness of 30-

44 mg/L. Copper accumulation was determined by atomic absorption spectroscopy. The copper redues in Clarias anguillaris exposed to 0.027, 0.0 dues in Clarias anguillaris exposed to 0.027, 0.055 and 0.11 mg copper/L for 8 weeks were 15.7, 21.8, and 31.17 mg/g dry weight, respectively. Oreochromis niloticus exposed to 0.05, 0.1, and 0.2 mg copper/L accumulated 34.69, 36.90, and 81.03 mg/g dry weight, respectively, over the 8 week period of exposure. The lowest and highest bioconcentration factors were 117 and 581 for Clarias anguillaris and 176 and 694 for Oreochromis niloticus. Copper concentrations in tissues of both species were directly related to the exposure concentrawere directly related to the exposure concentrations and the duration of exposure. Increased accumulation towards the last 2 weeks of exposure may be due to impaired capacity of elimination or poor nutritional status. (Author's abstract) W90-07132

ASSESSMENT OF STABLE NITROGEN ISOTOPES IN FINGERPRINTING SURFACE WATER INORGANIC NITROGEN SOURCES, Louisiana State Univ., Baton Rouge. Nuclear Science Center.
For primary bibliographic entry see Field 5A. W90-07134

60CO RETENTION BY A FRESHWATER PLANKTONIC ALGA SCENCEDESMUS OBLI-

QUUS. CEA Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance (France). Inst. de Protec-tion et de Surete Nucleaire. R. Nucho, and J. P. Baudin. Environmental Pollution ENPOEK, Vol. 62, No.

4, p 265-279, 1989. 4 fig, 47 ref.

Descriptors: *Algae, *Bioaccumulation, *Cobalt radioisotopes, *Path of pollutants, *Phytoplankton, *Radioactive wastes, *Scenedesmus, Chelating agents, Decontamination, Sodium chloride, Water

A recent literature review showed that a great deal A recent literature review showed that a great deal of research has been carried out on the accumulation of metals by phytoplankton. Little data, however, is available regarding radionuclides, especially 60Co. An experimental research program examined the ways in which 60Co was transferred to freshwater ecosystems. The first results showed that 60Co fixation was massive and extremely rapid in Scenedesmus obliquus. The results of sev-eral decontamination experiments, whose purpose was to evaluate 60Co retention by Scenedesmus obliquus under various experimental conditions corresponding to situations encountered in situ, or to different phases in the development cycle of an algal population are presented. The physiological condition of cells was not involved in radiocolbalt desorption, which seemed to indicate that the phenomenon was of a passive nature. When the pre-contamination time was extended, the proportion of adsorbed 60Co decreased, and the final percent-age of radionuclide retained increased. These reage of radionucinue retained increases. Insee te-sults were confirmed by bringing cells into contact with a strong chelating agent. The limitation of 60Co in the presence of EDTA underwent a sharp decrease which was correlated with the increase in the duration of the precontamination phase. The use of a weaker complexing agent, such as NaCl, led to the hypothesis of there being 2 types of 60Co receptor on cell membranes. (Mertz-PTT) W90-07137

IMPACT OF ARTIFICIAL AMMONIUM-EN-RICHED RAINWATER ON SOILS AND YOUNG CONIFEROUS TREES IN A GREEN-HOUSE, PART 1-EFFECTS ON THE SOILS.
Katholicke Univ. Nijmegen (Netherlands). Dept. of Aquatic Ecology and Biogeology.
For primary bibliographic entry see Field 5C.
W90-07138

FATE OF MONOCROTOPHOS IN THE ENVI-RONMENT

Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Agricultural Products Dept. P. W. Lee, J. M. Fukuto, H. Hernandez, and S. M.

Journal of Agricultural and Food Chemistry JAFCAU, Vol. 38, No. 2, p 567-573, February 1990. 3 fig, 8 tab, 8 ref.

Descriptors: *Agricultural chemicals, *Fate of polhutants, *Insecticides, *Path of pollutants, Agricultural hydrology, Azodrin, Cotton, Degradation products, Monocrotophos, Thin layer chromatography.

Monocrotophos, the active ingredient for Azodrin insecticide, is effective against a wide spectrum of phytophagous insects and mites. In addition to its high contact toxicity, monocrotophos also possesses systemic and residual activity when applied directly to the stems of cotton plants. The fate of monocrotophos in the aqueous and soil environ-ment was examined. Hydrolysis rates for monocrotophos are pH-dependent and follow first-order kinetics. The half-live of monocrotophos in pH 3 buffer solution at 25 C is 131 days, while in pH 9 buffer it's 26 days. N-Methylacetoacetamide and O-desmethylmonocrotophos were the major hy-drolytic degradation products detected. There was no observable qualitative or quantitative difference when the aqueous and soil experiments were con-ducted in the dark or with exposure to sunlight. Soil metabolism studies showed rapid and extensive decomposition of monocrotophos and it soil metabolites to 14CO2 and unextractable residues.

metabolites to 14CO2 and unextractable residues. N-Methylacetoacetamide, N-(hydroxymethyl)monocrotophos, and 3-hydroxy-N-methylbutyramide were detected as soil degradation products. Soil thin layer chromotography data indicated that monocrotophos was mobile under test conditions. Rotational crops planted at various time intervals after soil treatment contributional low. If any significant residue layels of tained low, if any, significant residue levels of monocrotophos or its metabolites. (Mertz-PTT)

W90-07175

PERSISTENCE, LEACHABILITY, AND LATERAL MOVEMENT OF TRICLOPYR (GARLON) IN SELECTED CANADIAN FOR-

Guelph Univ. (Ontario). Dept. of Environmental Biology.

G. R. Stephenson, K. R. Solomon, C. S. Bowhey, and K. Liber.

Journal of Agricultural and Food Chemistry JAFCAU, Vol. 38, No. 2, p 584-588, February 1990. 3 fig, 4 tab, 9 ref.

Descriptors: *Fate of pollutants, *Herbicides, *Path of pollutants, *Pesticides, *Triclopyr, *Water pollution sources, Canada, Clay soils, Environmental effects, Leaching, Sandy soils, Soil

Triclopyr, a pyridine herbicide, is highly active for the control of broad-leaved weeds and brush but has little activity on grasses. Although triclopyr has been used for several years to control brush in rangelands of the U.S., it is just now being consideration of the configuration of the configuration of the configuration. rangelands of the U.S., it is just now being considered for use on rights-of-way and for conifer release in Canada. A number of possible sites were investigated in the Matheson area of Northern Ontario. Triclopyr., (3,5-6-trichloro-2-pyridyl)oxy)acetic acid, Garlon 4E,) was moderately persistent in sandy and clay soils at the Northern Ontario site. Time to 50% disappearance was 2 weeks and 90% for 4 weeks, regardless of soil type. Evidence of triclopyr leaching in response to heavy rainfall was observed 7 days after application in both soils, but residues of triclopyr at a depth of 25-30 cm never exceeded 6 microapplication in both soils, but residues of triclopyr at a depth of 25-30 cm never exceeded 6 microgram/kg, when present. In a study of lateral movement of triclopyr with runoff water, residues (in the range 0.01-0.96 microgram/L) were recovered in a collection ditch 12-13 m downslope; however, there were no evidence of more movement of triclopyr. there was no evidence of mass movement of tyri-clopyr at quantifiable levels (0.54 microgram/kg) downslope in the soil. Field studies of persistence and mobility confirmed earlier laboratory results and indicate that environmental problems are unlikely to occur as a result of excessive triclopyr persistence and/or mobility in soils typical of Northern Ontario forestry areas. (Mertz-PTT)

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution-Group 5B

RECOVERY OF VIRUSES AND BACTERIA IN WATERS OFF BONDI BEACH: A PILOT STUDY

Metropolitan Water, Sewerage and Drainage

Board, Sydney (Australia).
C. S. W. Kueh, and G. S. Grohmann.
Medical Journal of Australia MJAUAJ, Vol. 151,
No. 11/12, p 632-638, December 1989. 2 fig, 1 tab,

Descriptors: *Australia, *Beaches, *Coxsackie virus, *Enteroviruses, *Pathogenic bacteria, *Pol-lutant identification, *Sewage bacteria, *Viruses, *Water pollution sources, Bacterial analysis, *Water pollution sources, I Marine pollution, Water quality.

A pilot study was conducted between February and April, 1989, on the occurrence of sewage-derived viruses and bacteria in the beach and near-shore waters off Bondi, Sydney, Australia. Enteroviruses were isolated from 41% of a total of 66 sewage, seawater, grease and sediment samples. Poliovirus vaccine strains accounted for 78% of the isolates. Adenoviruses were isolated four times and covered covered income. the isolates. Adenoviruses were isolated four times and coxsackievirus B was isolated twice in samples that were collected away from the bathing area. Rotavirus and hepatitis A virus were not detected. The number of fecal coliforms, fecal streptococci, Aeromonas hydrophila and Clostridium perfringen in the sewage ranged from 10,000 to 10,000,000 colony-forming units (cfu)/100 mL. An initial reduction of 100-1000 in bacterial counts was observed in the plume (the effluent's initial dilution zone) and further reduction of 100-10,000 in counts in samples that were collected away from the plume. Salmonella were detected in one-third of the samples and low numbers of Campylobacter jejuni were found in the sewage and plume. Salmonella were detected in one-third of the sampies and low numbers of Campylobacter jejuni were found in the sewage and plume. Salmonella serotypes that were associated with the sewage and plume were distinct from those in the stormwater and beachwater, indicating that stormwater may be an important source of pollution on Bondi beach. (Author's abstract) Bondi beac W90-07177

BIOACCUMULATION OF CADMIUM BY THE FRESHWATER ISOPOD ASELLUS AQUATICUS (L.) FROM AQUEOUS AND DIETARY

SOURCES. Vrije Univ., Amsterdam (Netherlands). Biological

Ny Conv., Amsterdam (Van den Bosch, B. Van Hattum, P. De Voogt, L. Van den Bosch, N. M. Van Straalen, and E. N. G. Joosse. Environmental Pollution ENPOEK, Vol. 62, No. 2/3, p 129-151, 1989. 2 fig, 8 tab, 64 ref. Free University of Amsterdam (USF grant 86-51-e).

Descriptors: *Bioaccumulation, *Cadmium, *Isopods, *Path of pollutants, Elodea, Fate of pollutants, Hydrogen ion concentration, Water pollution.

Experiments were conducted to determine the kinetics and relative importance of aqueous and dietary uptake of cadmium by the freshwater isopod Asellus aquaticus. Test animals were exposed during 30 days to aqueous Cd in a continuous flow system (exposure levels: 0.2-10 microgram/L) and kept on a diet of previously contaminated Elodea kept on a diet of previously contaminated Elode sp. (range of Cd concentrations: 2-350 microgram, g, dry weight). Preceding semi-static experiments on dosage-control of the dietary factor revealed a on dosage-control of the dietary factor revealed a rapid uptake of Cd by Elodea, with relatively high concentration factors (CF), which ranged from 4.8-5.5 (dry weight log (CF) after 16 days). For Asellus uptake from water appeared to be the predominant route. Highly significant bioconcentration of Cd from water was observed in the animals, even at exposure levels below 1.0 microgram/L. In the various treatments, direct uptake from water accounted for 50-98% of the body burdens after 30 days exposure. The experimental results were described with a first-order one-comresults were described with a Inst-order one-compartment bioaccumulation model. Model parameter estimates (mean +/-standard error) were obtained for rate constant of uptake (56 +/-110/day), rate constant of elimination (0.032 +/-0.017/day) and assimilation efficiency of Cd uptake from food (1.1 +/-0.7%). The (dry weight) bioconcentration factor (BCF) and bioaccumulation factor (BAF) for extrapolated steady-state conditions were estimated at 18,000 (BCF) and 0.08 (BAF). Experiments conducted at two different pH levels (5.9 vs.

7.6) revealed no significant effects of pH on the uptake of aqueous Cd by the isopods. It is probable that the bioavailability of Cd in natural freshwater systems will be substantially less than in the present experiments as a result of the presence of numic acids and some ligand binding substances. (Author's abstract) W90-07192

FORMALDEHYDE LEVELS IN AIR AND WET PRECIPITATION AT MEXICO CITY.

MEARO. Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ciencias de la Atmosfera. A. P. Baez, R. D. Belmont, O. G. Gonzalez, and I. P. Rosas.

Environmental Pollution ENPOEK, Vol. 62, No. 2/3, p 153-169, 1989. 4 fig, 6 tab, 29 ref.

Descriptors: *Atmospheric chemistry, *Chemistry of precipitation, *Formaldehyde, *Mexico, *Path of pollutants, Air pollution, Mexico City, Rain.

Formaldehyde concentrations in ambient air and in rain water were measured at the University of Mexico, Mexico City. Air samples were taken twice a day, from 9:00 to 13:00 h and from 13:00 to 16:00 h local time from July to December 1985. Rain water was collected on a daily basis from July to October, i.e. during the rainy season. The ambient air mean value was 0.0244 ppmv for morning hours, while the afternoon mean value was 0.0185 ppmv. The formaldehyde concentration in wet precipitation ranged from 0.10-0.80 mg/L (3.3-26.6 micromol/L), with a mean value of 0.41 mg/L (13.7 micromol/L). A comparison of the results with some measurements made at remote maritime sites, rural and suburban areas, indicated that the Formaldehyde concentrations in ambient air and in with some measurements made at remote maritime sites, rural and suburban areas, indicated that the formaldehyde levels in the atmosphere and rain water of Mexico City are among the highest reported in the literature, including data reported for Los Angeles, California, during severe photochemical pollution conditions. (Author's abstract) W90-07193

PHTHALATE ESTER SPECIATION IN ESTUA-RINE WATER, SUSPENDED PARTICULATES AND SEDIMENTS.

AND SEDIMENTS. Liverpool Univ. (England). Oceanography Lab. M. R. Preston, and L. A. Al-Omran. Environmental Pollution ENPOEK, Vol. 62, No. 2/3, p 183-193, 1989. 3 fig, 5 tab, 8 ref.

Descriptors: *Estuaries, *Particulate matter, *Path of pollutants, *Phthalates, *Sediment chemistry, *Suspended sediments, *Water chemistry, *Water pollution, England, Lipids, Liverpool, Organic carbon, River Mersey Estuary.

Following earlier work in which phthalate ester speciation was examined in laboratory studies, this paper describes the results of an attempt to validate the results by field paper describes the results of an attempt to vanishing the results by field measurements in the River Mersey Estuary, Liverpool, UK. Samples of water, suspended solids and sediments were analyzed for their phthalate ester content. Solid samples were tory results confirms the association between dieth-ylhexyl phthalate and small particles and shows that other phthalates tend to be associated with relatively coarse, lipid-rich particles. Partition co-efficients between dissolved phthalate esters and suspended particles are calculated and compared with other laboratory studies. (Author's abstract) W90-07195

POLYCHLORINATED BIPHENYLS (PCBS) IN SEDIMENTS IN HONG KONG: A CONGENER-SPECIFIC APPROACH TO THE STUDY OF COPLANAR PCBS IN AQUATIC ECOSYS-

Ehime Univ., Matsuyama (Japan). Dept. of Envi-

Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.

N. Kannan, S. Tanabe, T. Okamoto, R. Tatsukawa, and D. J. H. Phillips.
Environmental Pollution ENPOEK, Vol. 62, No. 2/3, p 223-235, 1989. 4 fig. 4 tab, 17 ref. Ministry of Education, Science and Culture of Japan project no. 60030060.

Descriptors: *Hong Kong, *Marine environment, *Path of pollutants, *Polychlorinated biphenyls, *Sediment contamination, Coastal waters, Sediment chemistry, Sediments, Water pollution.

Patterns of contamination by polychlorinated biphenyls (PCBs) were investigated in 14 samples of
coastal sediments from Hong Kong. Congenerspecific analyses revealed 9 sediment samples from
Junk Bay to contain PCBs at concentrations ranging from 31-2200 ng/g dry weight, concentrations
generally increasing with distance north in the
Bay. By contrast, 5 sediments from the Tolo area
to the northeast of Hong Kong exhibited total PCB
levels of only 6.6-45 ng/g dry weight. The patterns
of relative abundance of PCB congeners in the
northern Junk Bay sediments suggested the existence of ongoing sources of PCBs in this area;
spiphenyls of lower chlorination were present at
high concentration in these samples. Three coplanar PCBs (3',44'-textchlorobiphenyl; 3,3',44',5',
pentachlorobiphenyl, and 3,3',4' a,5',5'-hexachlorobiphenyl) were found to be present in Junk Bay
sediments; these are highly toxic and are cause for biphenyl) were found to be present in Junk Bay sediments; these are highly toxic and are cause for concern in aquatic environments. The abundance of the 3 coplanar PCBs in the sediments studied was similar to that in commercial PCB mixtures, suggesting that these congeners are not enriched over other PCBs by the sediments of coastal ecosystems. It is concluded that the preferential enrichment of coplanar PCBs occurs in the biosphere rather than in sediments. (Author's abstract) W90_07107

TEMPORAL TRENDS OF ORGANOCHLOR-INE RESIDUES IN LIZARD GOBY RHINOGO-BIUS FLUMINEUS FROM THE RIVER NA-GARAGAWA, JAPAN.

Ehime Univ., Matsuyama (Japan). Dept. of Envi-ronment Conservation.

B. G. Loganathan, S. Tanabe, M. Goto, and R. Tatsukawa.

Environmental Pollution ENPOEK, Vol. 62, No. 2/3, p 237-251, 1989. 9 fig, 1 tab, 30 ref.

Descriptors: *Bioaccumulation, *Fish, *Japan, *Organochlorine compounds, *Path of pollutants, *Rivers, *Water quality trends, Chlordane, DDT, Insecticides, Polychlorinated biphenyls, River Na garagawa, Water pollution.

PCBs, DDTs, HCHs (BHCs) and chlordane com-pounds were analyzed in lizard goby, Rhinogobius flumineus, collected from the River Nagaragawa, Japan during the period from 1968-86. High resi-due levels of PCBs, DDTs and HCHs were found due levels of PCBs, DDTs and HCHs were found during the late 1960s and early 1970s. From the early 1970s, the residual levels started declining and the lowest levels were reached during the 1980s. In 1986, the residual concentrations of PCBs, DDTs and HCHs were 150, 6.2 and 2.2 ng/g which were 100, 100 and 210 times less than the highest values recorded during the years 1969, 1968 and 1970 respectively. Unlike these pollutions of the pollut and 170 respectively. Office these points and specific an W90-07198

PERMEABILITY OF AIR AND IMMISCIBLE ORGANIC LIQUIDS IN POROUS MEDIA.

ORGANIC LIQUIDS IN PUROUS MEDIA.

Battelle-Northwest, Richland, WA.

J. W. Cary, C. S. Simmons, and J. F. McBride.

Water Resources Bulletin WARBAQ, Vol. 25, No.
6, p 1205-1216, December 1989. 6 fig., 4 tab, 18 ref.

U.S. Department of Energy Contract DE-ACO6-76RLO 1830.

Descriptors: *Oil, *Path of pollutants, *Permeabil-ity, *Porous media, *Soil contamination, *Soil gases, Conductivity, Groundwater pollution, Haz-ardous wastes, Immiscibility, Loam, Organic com-pounds, Sand, Silt, Soil porosity, Soil types, Soil

The conductivity of air, mineral oil (relative viscosity 77), and a light nontoxic oil (relative viscosity 4.7) was measured in three porous media: a sand, loamy sand, and a silt loam. The measurements

Group 5B-Sources Of Pollution

were made over a range of water contents for each porous medium. Small volumes of air were present as well as significant amounts of water during most of the oil conductivity measurements. The results of the oil conductivity measurements. The results were compared to two methods for calculating conductivities of immiscible fluids in water-wet porous media. A new equation that accounts for swelling and for the gas slippage effect in very small pores was formulated for use with these methods. The observed conductivities, spanning seven orders of magnitude, agree reasonable well with calculated values. Only three soil parameters are required to calculate the conductivities: (1) the saturated conductivity of water. (2) the saturated saturated conductivity of water, (2) the saturated conductivity of the immiscible fluid of interest, and (3) a pore size index value that is obtained from an (3) a pore size index value that is obtained from an estimate from the water release curve of the porous material. Remediation of organic liquid spills is briefly discussed to illustrate the practical applications of gas phase conductivities, as well as those for immiscible organic liquid phases. In light of spatial variation under field conditions, the method presented for calculating values of three-phase conductivities will be useful in the management of immiscible organic liquid spills and leaks. (Author's abstract) W90-07210.

LEAD AND CADMIUM ASSOCIATED WITH SALTWATER INTRUSION IN A NEW JERSEY AOUIFER SYSTEM.

AQUIFER SYSTEM.
Geological Survey, West Trenton, NJ.
A. A. Pucci, D. A. Harriman, E. M. Ervin, J.
Bratton, and A. Gordon.
Water Resources Bulletin WARBAQ, Vol. 25, No.
6, p 1267-1272, December 1989. 2 fig, 2 tab, 22 ref.

Descriptors: *Aquifer systems, *Cadmium, *Groundwater pollution, *Lead, *New Jersey, *Saline water intrusion, *Water pollution sources, Chlorides, Path of pollutants, Potomac-Raritan-Magothy Aquifer System, Wells.

The U.S. Geological Survey collected groundwater samples from the upper and middle aquifers of the Potomac-Raritan-Magothy aquifer system in a 400-square-mile area of New Jersey from 1984-1986. Concentrations of lead were greater than the U.S. Environmental Protection Agency maximum contaminant level (MCL) of 50 micrograms/L in water from 16 of 239 wells. The concentrations of cadmium were greater than the MCL of 10 micrograms/L in water from 10 of 241 wells. One-half of the wells that exceeded the lead MCL were in known areas of saltwater intrusion, as were all 10 tine wells that exceeded the lead MCL were in known areas of saltwater intrusion, as were all 10 wells that exceeded the cadmium MCL. The asso-ciation of elevated concentrations of these metals with elevated concentrations of chloride indicates mechanism related to saltwater intrusion. (Author's abstract)

LEACHATE QUALITY FROM GYPSUM NEU-TRALIZED RED MUD APPLIED TO SANDY

TRALIZED RED MUD APPLIED TO SANDY SOILS. Murdoch Univ. (Western Australia). School of En-vironmental and Life Science. For primary bibliographic entry see Field 2G. W90-07217

INTERSPECIFIC DIFFERENCES IN MANGA-NESE LEVELS IN FRESHWATER BIVALVES. Cleveland State Univ., OH. Dept. of Geological

M. J. S. Tevesz, G. Matisoff, S. A. Frank, and P. L. McCall.

Water, Air and Soil Pollution WAPLAC, Vol. 47, No. 1-2, p 65-70, September 1989. 1 fig. 4 tab, 9 ref.

Descriptors: *Bioaccumulation, *Clams, *Manganese, *Path of pollutants, Bioindicators, Mollusks, Neutron activation analysis, Ohio, Water pollution.

Vital effects may be important in determining metal levels in bivalves and must be taken into metal levels in bivalves and must be taken into account before the environmental 'meaning' of the data may be interpreted. Manganese concentrations in shells and soft tissues of several species of freshwater bivalves from three recent environments in northern Ohio and one archeological site

from southern Ohio were determined by neutron activation analysis. A species effect is shown where Fusconaia flava Mn levels > Anodonta where rusconas have Mn levels Anodonia grandis grandis levels > or = all Lampsilis species levels. Mn is concentrated by a factor of 2-25 in soft tissues compared to shells. In addition, within-taxon variability of Mn concentration is high. The high intra-species variability points to the necessity of processing many individuals before reliable numbers may be obtained. (Author's abstract)

VOLATILIZATION OF ORGANIC CHEMICALS FROM WATER.
Bogazici Univ., Istanbul (Turkey). Inst. of Envi-

ronmental Sciences Water, Air and Soil Pollution WAPLAC, Vol. 47, No. 1-2, p 71-79, September 1989. 3 fig, 4 tab, 22

Descriptors: *Mass transfer, *Path of pollutants, *Volatile organic compounds, *Water pollution, Benzenes, Chlorinated hydrocarbons, Naphtha-lenes, Oxygen, Phenols, Toluene, Water chemistry,

Liquid-phase transfer coefficients of 10 selected organic pollutants were measured simultaneously with the oxygen reaeration coefficient in a 2 L reactor. The contents of the reactor were stirred in the laboratory by a 0.15 m diameter propeller attached to a constant speed motor. The ratio of the mass transfer coefficient of the chemical to that the mass transfer coefficient of the chemical to that of oxygen is found to vary between 0.43 and 0.60 for 8 of the chemicals tested (toluene, o-xylene, naphthalene, biphenyl, tetrachloroethylene, chlor-obenzene, ethylbenzene, trichloroethylene). This obenzene, ethylbenzene, trichloroethylene). This result is in good agreement with the literature concerning high volatility chemicals. The value of this ratio was 0.10 for nitrobenzene and 0.01 for phenol, confirming the predominance of gas phase resistances in the transport process for these two compounds. (Author's abstract) W90-07220

BEHAVIOR OF RUNOFF-DERIVED METALS IN A DETENTION POND SYSTEM. Oregon Graduate Center, Beaverton. Dept. of En-vironmental Science and Engineering. K. Mesuere, and W. Fish. Water, Air and Soil Pollution WAPLAC, Vol. 47, No. 1-2, p 125-138, September 1989. 4 fig, 3 tab, 38 ref.

Descriptors: *Fate of pollutants, *Heavy metals, *Path of pollutants, *Surface detention, *Urban runoff, Cadmium, Copper, Lead, Parking lots, Storm runoff.

The removal and fate of runoff-derived heavy metals in a 1-yr old detention pond system were investigated during climatic conditions typical of the U.S. maritime Northwest. The catchment was a medium-sized, suburban parking lot near Port-land, Oregon. Water samples from runoff, the detention pond system, and pond effluent were col-lected and analyzed for dissolved and particulate Cu. Cu was the dominant toxic metal for the study site, while analysis of selected samples for Pb and Cd showed these metals to be minor pollutants. Cd showed these metals to be minor pollutants. Total Cu in runoff varied among different storm events over a wide range of concentrations (<2 to 33 microgram/L), while total Cu levels in pond effluent remained within a fairly narrow range (5 to 12 microgram/L). Bediment samples collected from the detention pond system were analyzed for Cu in two size fractions (<63 micron and <125 micron). All of the detention pond system were analyzed for Cu in two size fractions (<63 micron and <125 micron). Cu was found to be deposited in the pond sediments in a small but highly concentrated plume (up. to 130 me/kg), extending a signily from the sediments in a small but highly concentrated plume (up to 130 mg/kg), extending axially from the runoff inlet pipe. Overall, results showed that low-cost, small-scale detention ponds can be a useful management practice for runoff from parking lot areas and can be of value in preserving the integrity of receiving waters. (Author's abstract) W90-07222

MERCURY LEVELS IN THE SEDIMENT, WATER, AND SELECTED FINISHES OF LAGUNA LAKE, THE PHILIPPINES.

Southeast Asian Fisheries Development Center, Iloilo (Philippines). Aquaculture Dept.

L. A. Cuvin-Aralar. Aquaculture AQCLAL, Vol. 84, No. 3/4, p 277-288, February 1990. 2 fig, 3 tab, 24 ref.

Descriptors: *Fish, *Lake sediments, *Lakes, *Mercury, *Path of pollutants, *Philippines, Atomic absorption spectrophotometry, Conductivity, Dissolved oxygen, Turbidity, Water analysis.

Monthly samples of sediment, water and commercially important species of fish, primarily Oreochromis niloticus and Chanos chanos, plus a few other species, were collected from the West Bay area of Laguna Lake, The Philippines from January to December 1987. Mercury levels were determined in all samples by cold vapor atomic absorption spectrophotometry. Results showed that sediment samples contained mercury levels ranging from 26.7 to 117 ppb. Mercury levels in the water were negatively correlated with conductivity and dissolved oxygen and positively correlated with turbidity. The mercury burden of the fish species samples was below the maximum permissible level set by the UN World Health Organization and US Federal Drug Administration of 0.05 ppm. No direct correlation was observed between mercury levels in sediment and fish. (Author's abstract) W90-07226

FIELD STUDIES OF THE SO2/AQUEOUS S(IV) EQUILIBRIUM IN CLOUDS.

Victoria Univ. of Manchester (England). Inst. of Science and Technology. M. Radojevic, B. J. Tyler, A. J. Wicks, M. J. Gay, and T. W. Choularton.

Atmospheric Environment ATENBP, Vol. 24A, No. 2, p 323-328, 1990. 1 fig, 2 tab, 22 ref.

Descriptors: *Acid rain, *Air pollution, *Bisulfites, *Cloud chemistry, *Sulfites, *Sulfur dioxide, Cloud liquid water, Formaldehyde, Hydrogen peroxide, Oxidation.

The total concentration of physically dissolved sulfur dioxide and the bisulfite and sulfite ions is designated by S(IV). Concentrations of S(IV) were measured in cloudwater at Great Dun Fell and compared with theoretical bisulfite (assuming equilibrium between aqueous and gaseous phases) in clouds. Detectable concentrations of S(IV) in the range of 1 to 17.2 micromol/cu dm were observed only in samples which contained low hydrogen peroxide concentrations, generally <1 micromol/cu dm. Concentrations of S(IV) were below the detection limit of 1 micromol/cu dm in samples which contained high hydrogen peroxide levels (1 to 80 micromol/cu dm) confirming that either sulfur dioxide or hydrogen peroxide acts as the limiting reagent in the oxidation of sulfur dioxide in cloudwater. Equilibrium bisulfite concentrations were estimated from the measured cloudwater pH, the gas phase sulfur dioxide concentration and the ambient temperature and found to be on average designated by S(IV). Concentrations of S(IV) were ent temperature and found to be on average about 5 times lower than the measured S(IV) con-centrations. The possible role of formaldehyde in stabilizing S(IV) in cloudwater is discussed. The kinetic data available in the literature suggest that the complexation reaction between S(IV) and formaldehyde is too slow to account for the observed difference between measured and calculatserved difference between measured and calcular-ed S(IV) concentrations over the typical lifetime of clouds in our study. S(IV) accounted for up to 10% of the sulfate measured in stored cloudwater samples. (Author's abstract) W90-07228

ATMOSPHERIC H2O2 FIELD MEASURE-MENTS IN A TROPICAL ENVIRONMENT: BAHIA, BRAZIL,

Institut fuer Spektrochemie und Angewandte Spektroskopie, Dortmund (Germany, F.R.).
P. Jacob, T. M. Tavares, V. C. Rocha, and D.

Atmospheric Environment ATENBP, Vol. 24A, No. 2, p 377-382, 1990. 5 fig, 2 tab, 36 ref.

Sources Of Pollution—Group 5B

Descriptors: *Acid rain, *Atmospheric chemistry, *Brazil, *Hydrogen peroxide, *Tropical regions, Air pollution, Chemistry of precipitation, Model studies, Oxidation.

The knowledge of atmospheric hydrogen peroxide levels in different parts of the globe is of great interest because gaseous H2O2 is involved with the gas phase radicals, which are the most important oxidizing species for the transformation of atmospheric pollutants. In addition, in acidic liquid phase, H2O2 is the major oxidizing agent for transforming sulfite into sulfate, and also for nitrite. Model calculations used for estimations and predictions of conversion rates of airborne matter call for comizance of H2O2 levels in distinct environtions of conversion rates of airborne matter call for cognizance of H2O2 levels in distinct environ-ments. Concentrations of hydrogen peroxide in atmospheric gas and liquid phases were determined for the first time in the tropical Southern Hemi-sphere. Measurements were carried out in the Sal-vador area, Bahia, both at the seaside and 500 m away from it as well as at 270 km inland, in a rural area, during March-April 1988. Gaseous hydrogen area, during March-April 1988. Gaseous hydrogen peroxide was collected by cryogenic and rain by wet-only sampling. Analyses were performed with the peroxyoxalate chemiluminescence method, employing a compact field apparatus. The measured gas phase concentrations ranged from 0.2 to 3.9 pb by volume compared to 0.01-0.6 pbb by volume obtained from measurements with similar seather-density in Portmund West Germany during volume obtained from measurements with similar methodology in Dortmund, West Germany, during summer. The corresponding concentration ranges in rainwater are 0.9-6.8 ppm by weight (Bahia) and 0.1-2.2 ppm by weight (Dortmund, summertime). Gas/liquid hydrogen peroxide equilibrium during rain events is only attained at precipitation rates below 1 mm/hr. (Author's abstract)

EFFECT OF FREEZING ON THE COMPOSI-TION OF SUPERCOOLED DROPLETS-I. RE-TENTION OF HCL., HNO3, NH3 AND H2O. Toronto Univ. (Ontario). McLennan Physical

For primary bibliographic entry see Field 2B. W90-07231

EFFECT OF FREEZING ON THE COMPOSITION OF SUPERCOOLED DROPLETS—II, RETENTION OF S(IV).

Toronto Univ. (Ontario). McLennan Physical

For primary bibliographic entry see Field 2B.

INFLUENCE OF BEDROCK GEOCHEMISTRY ON THE HEAVY METAL CONTENT OF STREAM WATER, MARINE WATER, MARINE SEDIMENTS AND ORGANISMS IN ST. JOHN,

Center for Energy and Environment Research, San Juan, PR.
For primary bibliographic entry see Field 2K.
W90-07238

MERCURY LEVELS IN THE PLUMAGE OF RED-BILLED GULLS LARUS NOVAEHOL-LANDIAE SCOPULINUS OF KNOWN SEX AND AGE.

AND AGE.
Glasgow Univ. (Scotland). Dept. of Zoology.
R. W. Furness, S. A. Lewis, and J. A. Mills.
Environmental Pollution ENPOEK, Vol. 63, No.
1, p 33-39, 1990. 1 fig. 1 tab, 19 ref.

Descriptors: *Bioaccumulation, *Gulls, *Mercury, *Path of pollutants, Birds, Feathers, Heavy metals, New Zealand, Waterfowl.

Samples of 4-8 small body feathers were taken from 27 chicks and 35 adult red-billed gulls caught at their nests on the Kaikoura Peninsula, New Zealand, in December 1988. The adults had been banded as chicks and were of known ages from 2 to 15 years old. Analysis of total mercury in the to 13 years old. Analysis of total mercury in the feather samples showed that levels were independ-ent of sex and age in adults. Mean fresh weight concentration in adult body feathers was 2.4 mi-crograms/gram. The lack of age accumulation of mercury in gull feathers contrasts with the well

known age related accumulation of mercury in tissues of fish and marine mammals, but agrees with predictions of recent studies on mercury dy-namics in birds. Mercury levels in chick feathers were about 80% of levels in adult feathers. (Author's abstract)

OBSERVATIONS OF THE OCEANIC ENVI-RONMENT AND WARM-WATER OUTFALL NEAR THE KOEBERG NUCLEAR POWER STATION, SOUTH AFRICA.

Cape Town Univ. (South Africa). Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W90-07244

ORGANOCHLORINES IN BOTTLENOSE DOLPHINS TURSIOPS TRUNCATUS FROM THE EAST COAST OF SOUTH AFRICA. Port Elizabeth Museum, Humewood (South

Africa).
V. G. Cockcroft, A. C. De Kock, D. A. Lord, a G. J. B. Ross.

South African Journal of Marine Science SJMSE7, Vol. 8, p 207-217, 1989. 7 fig, 4 tab, 41 ref.

Descriptors: *Chlorinated hydrocarbons, *Coastal waters, *Marine mammals, *Path of pollutants, Animal physiology, Biological studies, DDE, Dieldrin, Polychlorinated biphenyls.

Concentrations of polychlorinated biphenyls (PCBs), t-DDT (DDT + DDE + DDD) and dieldrin were determined in blubber samples of 105 bottlenose dolphins inhabiting the coastal waters off the east coast of South Africa. Residue concentrations increased with age and, in males, reached levels that may impair testosterone production. In females, however, there was a decline in concentration of all three residues in animals with between 8 and 10 dentinal growth layer groups. A significant difference was found between residue levels in females before and subsequent to their first or second ovulation, suggesting that first-born calves receive the majority of the mother's load through lactation. The evidence indicates that primiparous females impart the majority of their load within seven weeks post-partum. Levels of PCBs, t-DDT and dieldrin differed significantly in different goographical areas, suggesting a degree of isolation of sections of the population. (Author's abstract) (PCBs), t-DDT (DDT + DDF dieldrin weer 1 W90-07246

ROLE OF MICROBIAL METAL RESISTANCE AND DETOXIFICATION MECHANISMS IN ENVIRONMENTAL BIOASSAY RESEARCH. Guelph Univ. (Ontario). Dept. of Environmental Biology. nary bibliographic entry see Field 5A. For primary W90-07260

LUMINESCENT BACTERIA TOXICITY ASSAY IN THE STUDY OF MERCURY SPECIATION. Saskatchewan Univ., Saskatoon. Toxicology Research Centre.

For primary bibliographic entry see Field 5C. W90-07262

USE OF AQUATIC MACROPHYTES AS A BIO-ASSAY METHOD TO ASSESS RELATIVE TOX-ICITY, UPTAKE KINETICS AND ACCUMU-LATED FORMS OF TRACE METALS. King's Coll., London (England). Div. of Biosphere

For primary bibliographic entry see Field 5A. W90-07280

PHYTOMONITORING OF PULVERIZED FUEL ASH LEACHATES BY THE DUCKWEED LEMNA MINOR.

LEMNA MINUK.
Keuring van Electrotechnische Materialen N.V.,
Arnhem (Netherlands). Environmental Dept.
H. A. Jenner, and J. P. M. Janssen-Mommen.
Hydrobiologia HYDRB8, Vol. 188/89, p 361-366,
December 1989. 1 fig, 5 tab, 26 ref.

Descriptors: *Aquatic plants, *Bioaccumulation, *Bioassay, *Duckweed, *Fuel ash leachates, *Leachates, *Metals, *Monitoring, *Water pollution sources, Acetie acid, Image processing techniques, Phytomonitoring, Toxicity

The duckweed Lemna minor is one of the smallest vascular plants with a known strong capacity for metal accumulation. L. minor is proposed as a phytomonitor for coal ash drainage systems for bioassay studies directed to complexation and speciation. The duration of the experiment can be restricted to fourteen days; it is then possible to determine accurately differences in growth of the clone forming plant by using image processing techniques. Leaching of pulverized fuel ash (PFA) with acetic acid according to EPA instruction resulted in effects attributed to the acetic acid itself rather than to the metals in solution. Toxic effects of both leachates, 'natural' and 'artificial' were determined. The order of toxicity of metals studied on ooin reachates, natural and artincial were determined. The order of toxicity of metals studied so far in separate metal experiments is Cd > Cu > Zn > As (Arsenite) > Se (Selenite) > Ge > B > Mo. (Author's abstract) W90-07282

EFFECTS OF ACIDITY ON ACUTE TOXICITY OF ALUMINIUM-WASTE AND ALUMINIUM-CONTAMINATED SOIL.

Hong Kong Polytechnic, Kowloon. Dept. of Applied Biology and Chemical Technology.

N. F. Y. Tam, Y. S. Wong, and M. H. Wong.
Hydrobiologia HYDRB8, Vol. 188/89, p 385-395,
December 1989. 2 fig. 4 tab, 16 ref.

Descriptors: *Acid rain effects, *Aluminum, *Bio-assay, *Soil contamination, *Toxicity, Acidic soils, Aluminum waste, Hydrogen ion concentration, Photosynthesis, Phytotoxicity, Root growth, Seed

The total heavy metal concentrations of Al-waste and Al-contaminated soil were many times higher than that found in the control soil, which might pose toxic effects on nearby ecosystems under acidic conditions. This study was designed to detect the amount of Al, Cu, Zn, Mn, Pb, Ni and Cd extracted by distilled water and ammonium acetate at pH 3.8, 4.8, 5.8, 6.8, and 7.8. Acute toxicities of water extracts were assessed using two bioassays. Results showed that concentrations of heavy metals, especially Al, were the highest in extracts from Al-contaminated soil extracted with NHAOAC followed by Alwaste. The control dis-NH4OAc, followed by Al-waste. The control dis-played relatively low levels of metals. More heavy NH40Ac, followed by Al-waste. The control displayed relatively low levels of metals. More heavy metals were extracted at acidic pH than at neutral pH. Distilled water extracts exhibited lower levels of metals than those extracted with NH40Ac. The first bioassay, in terms of seed germination and root elongation of B. parachinensis, indicated that the germination rates were seriously retarded by Al-waste even at neutral pH. Less than 25% of the seeds were germinated in Al-waste and the toxic effect was more obvious at pH 3.8. Root growth in Al-waste and Al-soil was slower than in the control and no seedling in Al-waste had roots longer than 2 cm at the end of the study. In the second bioassay, the photosynthetic rate of Chlorella pyrenoidosa was significantly inhibited by Al-waste when compared with the control, although the pH effect was not clear. This study revealed that the metal availability was pH dependent and their toxicity could be rapidly assessed by two simple bioassays. (Author's abstract)

PHYSIOLOGICAL BACKGROUND FOR USING FRESHWATER MUSSELS IN MONITORING COPPER AND LEAD POLLUTION. Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).

For primary bibliographic entry see Field 5A. W90-07292

EFFECT OF HEAVY METAL SPECIATION IN SEDIMENT ON BIOAVAILABILITY TO TUBI-

Water Research Centre, Medmenham (England). Medmenham Lab.

Group 5B-Sources Of Pollution

A. M. Gunn, D. T. E. Hunt, and D. A. Winnard. Hydrobiologia HYDRB8, Vol. 188/89, p 487-496, December 1989. 4 fig, 1 tab, 20 ref.

Descriptors: *Benthic fauna, *Bioassay, *Bioavai-lability, *Heavy metals, *Path of pollutants, *Sedi-ment contamination, *Speciation, *Toxicity, Ad-sorption, Cadmium, Carbonates, Clays, Copper, Hydrous ferric oxide, Lead, Nickel, Sewage sludge, Tubificids, Zinc.

The bioavailability of heavy metals in sediment to freshwater tubificid worms was compared with measures of chemical extractability using a sequential extraction procedure. In order to provide a range of test sediments of different quality, various mineral phases were prepared, in which the metals were spiked by absorption or coprecipitation and these were then mixed with a bulk base sediment in leaven proportions. Results indicated good correknown proportions. Results indicated good corre-lation between worm metal burden and metal mo-bilized from the sediments in the first ('exchangeable') sequential extraction step for copper, cadmi-um, and lead. Of the other metals tested, zinc levels in the worms were constant, suggesting reg-ulation, and nickel uptake was too small for accuunation, and nicket uptake was too small for accurate measurement. In general, metals spiked to the sediment directly, or adsorbed on the clay mineral phase were much more available than those bound to sewage sludge, carbonate or hydrous ferric oxide phases. (Author's abstract)
W90-07296

METAL ACCUMULATION BY CHIRONOMID LARVAE: THE EFFECTS OF AGE AND BODY WEIGHT ON METAL BODY BURDENS.

Ontario Ministry of the Environment, Toronto. Water Resources Branch.

G. Krantzberg. Hydrobiologia HYDRB8, Vol. 188/89, p 497-506, December 1989. 2 fig, 3 tab, 39 ref.

Descriptors: *Aquatic insects, *Bioaccumulation, *Bioassay, *Calcium, *Heavy metals, *Midges, *Monitoring, *Path of pollutants, Age, Bioavailability, Cadmium, Copper, Growth, Iron, Larvae, Manganese, Nickel, Size.

Age and body weight affected the extent of metal retention in larval chironomids. Elements differed with respect to age-dependent and size-dependent metal uptake. The slopes of the regressions of metal uptake. The slopes of the regressions of metal burdens against age and size varied depending on the range in body size considered. Among fourth instar larvae, younger chironomids had higher concentrations of Cd, Mn, Ca, Ni, Fe, and Cu than older instars. When all instars were included, only concentrations of Cd and Ni were greater in young as compared to older larvae. Concentrations of Fe, Mn, Ca, and Ni were greater in large chironomids than smaller larvae of similar age, but the effect of body weight on metal content was the effect of body weight on metal content was significant only when a wide range in biomass was considered. For the design of biological monitor-ing programs that use information on tissue residues of contaminants to assess contaminant bioa-vailability, individuals of different ages and sizes should be collected from each site in order to validate intersite comparisons. (Author's abstract)

PRELIMINARY INVESTIGATIONS ON THE INFLUENCE OF SUSPENDED SEDIMENTS ON THE BIOACCUMULATION OF TWO CHLOROBENZENES BY THE GUPPY (POECI-

CHLDROBENZENES BY THE GUPTY (POECL-LIA RETICULATA).

Amsterdam Univ. (Netherlands). Lab. of Environ-mental and Toxicological Chemistry.

S. M. Schrap, and A. Opperhuizen.

Hydrobiologia HYDRB8, Vol. 188/89, p 573-576, December 1989. 4 fig. 7 ref.

*Benzenes, *Bioaccumulation, **Chlorinated hydrocarbons, *Fish physiology,
Path of pollutants, *Suspended sediments, Guppies, Hexachlorobenzene, Trichlorobenzene.

The uptake by guppies (Poecilia reticulata) of 1,2,3-trichlorobenzene (TCB) and hexachlorobenzene (HCB) from sediment-free water was compared with uptake in the presence of suspended

sediment. The results show that the influence of suspended sediment on the uptake of chlorobenzenes varies with test compound. TCB uptake was not influenced by the presence of suspended sediment. This finding is probably due to the large amount of the chemical which is dissolved relative amount of the chemical winch is dissolved relative to the amount which is present in the sorbed state. For the more hydrophobic HCB, the concentra-tion found in the fish from the system with sus-pended sediment was significantly higher than in fish from the control experiment. (Author's abstract) W90-07304

NITRIFICATION RATES IN THE LOWER RIVER RHINE AS A MONITOR FOR ECO-LOGICAL RECOVERY.

Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Bilthoven (Netherlands). Y. J. H. Botermans, and W. Admiraal. Hydrobiologia HYDRB8, Vol. 188/89, p 649-658,

December 1989. 9 fig, 27 ref.

Descriptors: *Fate of pollutants, *Monitoring, *Ni-trification, *Rhine River, *Toxicity, *Water qual-ity, Data interpretation, Dissolved oxygen, Rivers, onal variation, Temperature

The rate of in situ nitrification was tested as an indicator of the toxicological quality of the river indicator of the toxicological quality of the river Rhine. Concentration changes of ammonium ions over 85 to 133 km long reaches of three river branches downstream of the densely populated Ruhr-area (F.R.G.) were calculated from a data base for the period 1972 to 1986. Concentrations of ammonium in the river exceeded values of 1 mg N/L in winter. Because of the very high input of ammonium, bacterial intrification dominated over other nitrogen processes. Relative rates of nitrifica-tion in the three river branches were proportional tion in the three river branches were proportional to the water temperature for the individual years. Nitrification rates in the river increased by a factor of 4 during the period of 1972 to 1986. Toxic substances, whose concentrations decreased in the same period of time, were proposed as inhibitors of in situ nitrification rather than e.g. a low oxygen saturation of the water. The improvement of the conditions in the river, indicated by the in situ rate of nitrification, was also documented by data on macrofauna and fish populations. (Author's abstract) W90-07312

CONDITIONAL STABILITY CONSTANTS AND CONDITIONAL STABILITY CONSTANTS AND BINDING CAPACITIES FOR COPPER (II) BY ULTRAFILTERABLE MATERIAL ISOLATED FROM SIX SURFACE WATERS OF WYOMING, USA.

MING, USA.

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.

J. P. Giesy, and J. J. Alberts.

Hydrobiologia HYDRB8, Vol. 188/89, p 659-679,
December 1989. 7 fig, 12 tab, 40 ref. DOE contract

EX-76-C-09-0819. EX-76-C-09-0819.

Descriptors: *Copper, *Heavy metals, *Model studies, *Path of pollutants, *Statistical analysis, *Water analysis, *Wyoming, Alkalinity, Binding capacity, Geochemistry, Hardness, Ligands, Speciation. Stability constants

Ultrafilterable material < 0.15 microm was collected from six Wyoming surface waters, for which the chemical limnology had also been determined. The material was separated into four nominal size-fractions and the binding capacity of each for copper was determined by a hyperbolic, site-saturation model. The conditional, overall, thermodynamic stability constants for binding of copper were determined by two discrete models: (1) The one-component and two-component Scatchard functions, and two continuous multiligand models; and (2) the one-component and three-component Gaussian Scatchard functions. The accuracy of the stability constants to predict the speciation of Cu(II) in the titration of the isolated fractions and of whole waters was evaluated by comparing the predictions of the thermodynamic, geochemical simulation model, GEOCHEM to those measured by selective ion electrode. The Cu-binding capac-ity of material retained by ultrafilters was positive-

ly correlated with the hardness and alkalinity of the surface waters, from which they were isolated as well as the percent ash content of the ultrafilter-retained material. The magnitude of the condition-al stability constant (K'sub i) decreased as the ratio as stability Constant (N suc) decreased as the ratio of the total Cu concentration to total concentration of Cu-binding sites increased. The cumulative frequency distribution of K'sub i was log-normally distributed. All four of the models used to estimate distributed. An load of the induces use of estimates the conditional stability constants gave reasonable prediction of the speciation of Cu for both fractionated and whole waters but, depending on the situation, the one-component or two-component stuation, the one-component of two-component Scatchard estimate generally gave the best predic-tions of the proportion of copper, which would be expected to be bound. (Author's abstract) W90-07313

SORPTION AND TRANSPORT OF PESTI-CIDES IN GROUND WATER: CRITICAL REVIEW.

Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science.

D. A. Sabatini, and T. A. Austin.

Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 3-15, January/February 1990. 6 fig, 1 tab, 30 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Pesticides, *Reviews, *Solute transport, *Sorption, Computer models, Desorption, Mathematical equations, Mathematical models, Prediction. Soil contamination

The appearance of pesticides in ground water ne-cessitates the accurate prediction of pesticide trans-port in ground water. Adsorption and desorption are major mechanisms affecting the movement of are major mechanisms affecting the movement of pesticides in ground water. Several modeling techniques are applicable to the prediction of pesticide transport in ground water. Both equilibrium and onequilibrium adsorption expressions have been developed. Physical nonequilibrium (mass transfer and diffusion limitation) models appear to describe and predict most accurately the pesticide transport observed experimentally. However, the governing equations are the most complex and costly to solve in terms of computer time and memory. Equilibrium expressions are solved more easily using analytical solutions available for simple conditions. The ical solutions available for simple conditions. The modeler must decide what level of sophistication of the adsorption/desorption processes is needed appropriate to the level of uncertainty of other soil parameters. (Rochester-PTT)
W90-07315

ATRAZINE AND METOLACHLOR IN SUB-SURFACE DRAIN WATER IN LOUISIANA.

Agricultural Research Service, Baton Rouge, LA. L. M. Southwick, G. H. Willis, R. L. Bengtson, and T. J. Lormand.

Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 16-23, January/February 1990. 2 fig, 2 tab, 23 ref.

Descriptors: *Fate of pollutants, *Herbicides, *Louisiana, *Path of pollutants, *Soil contamination, Atrazine, Leaching, Maize, Mathematical analysis, Metolachlor, Soil profiles, Soil water.

Atrazine and metolachlor were applied preemergent to corn in plots that were either drained (10-cm plastic tubes, 1 cm deep) or undrained. Herbicide concentrations in the soil profile down to 30 cm and in the drain water were measured for 243 days. The pesticides showed a steady disappearance from the soil with pseudo-first-order half-lives (no. difference, between drained and undrained ance from the soil with pseudo-first-order half-lives (no difference between drained and undrained plots) in the top 2.5 cm of soil of 35-36 days for atrazine and 20-23 days for metolachlor. Total loss of atrazine through soil leaching amounted to 0.038% of the application rate; 97% of this loss occurred within 78 days after application during a period of 530 mm of rain. All (0.13% of that applied) of the metolachlor in the drain was observed within 59 days after application. The results of the present study illustrate the strong correlation between pesticide soil persistence, water solubility, rainfall timing, and pesticide leaching through soil. (Author's abstract)

Sources Of Pollution—Group 5B

W90-07316

VALIDATING GLEAMS WITH FIELD DATA FOR FENAMIPHOS AND ITS METABOLITES. Agricultural Research Service, Tifton, GA. South-east Watershed Research Lab.

R. A. Leonard, W. G. Knisel, F. M. Davis, and A.

Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 24-35, January/February 1990. 3 fig, 24 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *GLEAMS Model, *Mathematical models, *Model studies, *Pesticides, *Simulation analysis, Coastal plains, Fenamiphos, Georgia, Groundwater pollution, Metabolism, Organophosphorus pesti-cides, Performance evaluation.

The GLEAMS (ground water loading effects of agricultural management systems) model was modified to simulate the generation and degradation of pesticide metabolites. Translocation of the metabolites within and through the root zone was considered. The modifications were verified and preliminary validation was made using field data. Results of model simulations for fenamiphos metabolities. Results of model simulations for fenamiphos meta-bolite concentrations in the root zone were com-pared with observed concentrations at a research site in the Georgia coastal plain. GLEAMS-simu-lated mass of fenamiphos, fenamiphos sulfoxide, and fenamiphos sulfone in the root zone compared nacci mass or renamiphos, renamiphos sulfoxide, and fenamiphos sulfone in the root zone compared favorably with field data within the variability of the data. Soil samples were taken periodically during the cropping season at depths corresponding to the GLEAMS model computational layers. The samples were analyzed for fenamiphos and its metabolities for comparison with model simulations. Simulated and observed concentrations with depth in the soil at selected dates corresponded closely. Results of the this limited validation give confidence that the model component is performing as conceptualized. The present additions to GLEAMS will be helpful to model users working with those nonvolatile pesticides that have toxic metabolites with mobility and persistence characteristics differing from those of their parent compounds. (Rochester-PTT)

ALDICARB IN VADOSE ZONE: REVIEW. Bureau of Reclamation, Denver, CO. Resource Suitability Branch.

I A Stover and I C Guitiens

J. A. Stover, and J. C. Gurtjens.

Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 36-49, January/February 1990. 5 fig, 2 tab, 42 ref.

Descriptors: *Fate of pollutants, *Insecticides, *Path of pollutants, *Reviews, *Solute transport, *Vadose zone, Aldicarb, Carbamate pesticides, Leaching, Sorption.

Learning, sorption.

Literature was reviewed concerning the sorption and transport of aldicarb, a carbamate insecticide that is extremely toxic and relatively water soluble and has been found in ground water across the United States. Leaching of such organic compounds poses a serious threat to ground water. Sorption is a critical factor determining how rapidly a pesticide will leach through the vadose zone. Aldicarb is adsorbed primarily by soil organic matter and to a lesser extent by clay minerals. The assumption of a local equilibrium between the soil particles and the pore fluid is not always correct. Aldicarb transport may be controlled by nonequilibrium effects. Certain agricultural management practices may reduce the threat to ground water from aldicarb residues; among these best management practices are: variation in the amount and timing of pesticide application, avoiding excessive ment practices are: variation in the amount and timing of pesticide application, avoiding excessive use of irrigation water, limiting aldicarb use to alternate years, and prior delineation of areas sensi-tive to aldicarb use so that alternatives to aldicarb can be considered. (Rochester-PTT)

PREFERENTIAL MOVEMENT OF PESTI-CIDES AND TRACERS IN AGRICULTURAL SOILS.

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.

T. S. Steenbuis, W. Staubitz, M. S. Andreini, J. Surface, and T. L. Richard.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 50-66, January/February 1990. 5 fig, 4 tab, 28 ref.

Descriptors: *Path of pollutants, *Pesticides, *Solute transport, Agriculture, Alachlor, Atrazine, Bromides, Carbamate pesticides, Carbofuran, Maize, Nitrates, Soil water, Tillage, Tracer studies, Triazine herbicides.

Carbofuran, alachlor, atrazine, potassium bromide (a tracer), and nitrate were applied to two tile-drained plots of corn, one of which is conventionally tilled and another that is no-till. Soil water samples were collected from the plots with suction lysimeters and ground-water samples were collected from wells and tile drains. The no-till plot first ed from wells and tile drains. The no-till plot first showed low concentrations of atrazine and alachlor ranging from 0.1 to 0.4 microgram/L below the root zone one month after application, but the conventionally-tilled plot showed no pesticides below the root zone until late fall, when atrazine was detected at 0.4 microgram/L. Dye studies indicated that in the no-till plots some of the pestide by the property of the pestide by the property surface-concide by the property surface-concide by the property surface-concider the property surf cide bypasses the root zone through surface-connected macropores, whereas in the conventionallythe root zone as a result of greater contact with in the root zone as a result of greater contact with the soil. Concentrations of bromide (which is not adsoil. Concentrations of bromide (which is not ad-sorbed) in samples collected from wells and sucsoroeg) in samples collected from wells and suc-tion lysimeters did not differ between the two plots. Nitrate was found only in the part of the profile that remained unsaturated throughout the experiment. (Author's abstract) W90-07319

MODELLING INTERCOMPARTMENT TRANSFER OF POLLUTANTS: THE CASE OF

RIANSFER OF POLLUTAINTS: THE CASE OF LEAD.

Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).

D. Van de Meent.

Science of the Total Environment STENDL, Vol. 90, p 41-54, January 1990. 6 fig, 3 tab, 12 ref.

Descriptors: *Heavy metals, *Hydrologic models, *Lead, *Model studies, *Path of pollutants, *The Netherlands, Interactions, Legislation, Management planning, Mass transfer, Solute transport.

The concentrations of pollutants in different environmental compartments (air, water, sediment, soil) are related to each other through the action of intercompartment mass transfer processes. The influence of such intercompartment mass transfer processes (air-soil and air-water exchange, soilgroundwater transfer, water-sediment exchange, etc.) on the fate of pollutants in the environment generally is very considerable, not only for organic substances, but perhaps even more for heavy metals. The extent of mutual influence of concenmetals. The extent of mutual influence of concentrations in specific environmental situations can be evaluated successfully by means of multimedia box models of the type originally proposed by Mackay and coworkers, provided that the rates of intercompartment mass transfer processes are adequately described. The use of steady-state and quasidynamic multimedia box models as diagnostic tools in evaluating the intercompartment dependence of the concentrations of lead is illustrated here by two the concentrations of lead is illustrated nere by two hypothetical environmental situations using data from The Netherlands. It is suggested that future legislation to control pollution in one compartment should consider its effect on the other environmenshould consider its effect of the other environmental compartments and that attempts should be made to incorporate multimedia modeling in procedures to derive environmental quality standards. (Author's abstract)
W90-07339

CADMIUM EXPOSURE AND HEALTH EF-FECTS AMONG RESIDENTS IN AN IRRIGA-TION AREA WITH ORE DRESSING WASTEWATER.

Institute of Environmental Health and Engineering, Beijing (China).

For primary bibliographic entry see Field 5C. W90-07340

LABORATORY STUDY OF CADMIUM EXPO-SURE IN LITTORINA LITTOREA IN RELA-TION THE ENVIRONMENTAL CADMIUM AND EXPOSURE TIME.

Universidad del Pais Vasco, Bilbao (Spain). Lab. Citologia-Histologia.

For primary bibliographic entry see Field 5A. W90-07341

HEAVY METAL CONTENTS OF PADDY FIELDS OF ALCACER DO SAL, PORTUGAL, Universidade Nova de Lisboa (Portugal). Faculdade de Ciencias e Tecnologia.

J. C. Fernandes, and F. S. Henriques

Science of the Total Environment STENDL, Vol. 90, p 89-97, January 1990. 1 fig, 4 tab, 37 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Mine wastes, *Path of pollutants, *Portugal, Copper, Iron, Lead, Manganese, Monitoring, Rice, Sado River, Tissue analysis, Zinc.

Recent claims of metal contamination in the lower reaches of Sado River, in the Alcacer do Sal region, Portugal, were investigated by carrying out metal surveys in the area. Fe, Mn, Zn, Cu, and Pb were measured in the soil and in rice plant parts (roots, shoots, and grain) and some weeds growing on the Sado banks near the paddy fields. The metal contents were similar to background concentrations, except for Zn and Cu, which were above those concentrations and reached their highest levels at Vale de Guizo, the monitored station located furthest upstream in the Sado River. At some sites, plant roots accumulated relatively large amounts of Fe, Mn, Zn, and Cu, but the shoot levels of these metals were within the normal range for rice plants. It is possible that varying, but significant, amounts of Fe associated with the roots significant, amounts of Fe associated with the roots were in the form of ferric hydroxide plaque covering their surfaces. Copper levels in the shoots of rice were below the normal contents cited for this plant in the literature. metal levels of river sedi-ments collected near Vale de Guizo seem to sup-port the possibility of some metal contamination of the Sado River, most probably derived from pyrite mining activity in the upper Sado basin. (Author's abstract) W90-07342

SPECIATION OF ALUMINIUM IN SURFACE

Ghent Rijksuniversiteit (Belgium). Inst. voor Nuk-

Gliefit Kijssanversitet (Beiglain). Inst. voor leaire Wetenschappen. For primary bibliographic entry see Field 2K. W90-07344

ENVIRONMENTAL ASPECTS OF PHOS-PHATE FERTILIZER PRODUCTION IN THE NETHERLANDS WITH PARTICULAR REFER-ENCE TO THE DISPOSAL OF PHOSPHOGYP-SUM.

Gezondheidsraad, The Hague (Netherlands). H. B. Van der Heijde, P.-J. Klijn, K. Duursma, D. Eisma, and A. J. De Groot. Science of the Total Environment STENDL, Vol.

90, p 203-225, January 1990. 1 tab, 60 ref, 6 append.

Descriptors: *Agricultural chemicals, *Heavy metals, *Phosphogypsum, *The Netherlands, *Waste disposal, Cadmium, Lead radioisotopes, Management planning, Nonpoint pollution sources, Polonium radioisotopes, Public health, Radioiso-topes, Radium radioisotopes, Uranium radioiso-

Committee 173/1 of the Health Council of The Netherlands advised the Dutch government on the problem of an acceptable destination of 2 million tons of waste gypsum from the Dutch fertilizer industry. Recommendations are presented here. Primary emphasis should be placed on developing processing alternatives to free the bulk of the waste gypsum from potentially deleterious components (i.e., cadmium, phosphates, 238U progeny, particu-

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larly 236Ra, 210Pb, and 210Po). Discharge of suffi-ciently 'clean' phosphogypsum into the Rhine delta would provide only a trivial increase in the marine calcium sulfate inventory. Another problem is that the objectionable elements also leave the plant in the finished fertilizer and are spread over agricultural land. Land surface storage of the gypsum waste could be considered an environmentally acceptable alternative only if the complete shielding of the ground water from leachate can be guaran-teed indefinitely. The contribution of the fertilizer industry to the cadmium burden of the environ-ment (both land and sea) could be reduced to some extent in the short term by the use of low-cadmium ores. (Rochester-PTT) W90-07345

LEACHING OF MUTAGENS INTO MINERAL WATER FROM POLYETHYLENETEREPHTH-ALATE BOTTLES.

Naples Univ. (Italy). Dipt. di Farmacologia Speri-

R. de Fusco, S. Monarca, D. Biscardi, R. Pasquini,

and C. Fatigoni. Science of the Total Environment STENDL, Vol. 90, p 241-248, January 1990. 1 fig, 1 tab, 15 ref.

Descriptors: *Food processing industry, *Leaching, *Mineral water, *Mutagens, Beverage containers, Organic compounds, Polyethyleneterephtha-

Polyethyleneterephthalate (PET) was tested as a rolyentylenteriphinatae (PET) was tested as source of mutagen contamination from bottles used for beverage packaging. PET bottles were filled with mineral water and stored in daylight and dark for different periods of time. The water samples were concentrated and the concentrates (non-vola-tile compounds) tested for mutagenicity using the tile compounds) tested for mutagenicity using the Ames test (static tests). Total organic carbon leaching was determined concurrently. leaching of mutagens was studied using dynamic tests: shaking distilled water in PET bottles. New methods were used to test the leaching potential of both volatile and non-volatile compounds: directly testing the mutagenicity in unconcentrated water stored in PET bottles and growing Salmonella strains directly in the plastic bottles. The results were positive only for the static test, which identified leaching of mutagens after 1 mo of storage in PET bottles. This activity was higher after storage in daylight. (Author's abstract) W90-07346

SIMILIATION OF BIODEGRADABLE ORGAN. IC CONTAMINANTS IN GROUNDWATER: 1. NUMERICAL FORMULATION OF PRINCI-

PAL DIRECTIONS.
Waterloo Univ. (Ontario). Inst. for Ground Water

K. T. B. MacQuarrie, E. A. Sudicky, and E. O.

Water Resources Research WRERAQ, Vol. 26, No. 2, p 207-222, February 1990. 12 fig, 2 tab, 45 ref. University Research Fellowship Grant U0508.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Model studies, *Organic compounds, *Path of pollutants, Bacteria, Biodegradation, Dissolved organic carbon, Groundwater movement, Hydrologic models, Mathematical models, Numerical analysis, Simulation analysis.

Groundwater contamination by organic chemicals is of concern because of the widespread use of is of concern occause of the whoespread use of these compounds and because even low concentra-tions may be very harmful. Dissolved organic con-taminants are affected by advection, dispersion, sorption, and biological transformations in ground-water systems; however, biological degradation by indigenous bacterial populations is the only mechaindigenous oacterial populations is the only mechanism whereby contaminant mass can be removed naturally from an aquifer. This study developed a physically and biochemically-based numerical solution for the transport of biodegradable organic solutes, with emphasis on an efficient numerical approach. A dual-Mondor relationship, combined with the advection-dispersion equation, was used to represent the biological and physical processes affecting the organic solute, electron acceptor, and microbial population. The three resulting differen-

tial equations are nonlinearly coupled through the Monod decay terms. By employing an iterative principal direction finite-element technique, efficiency is achieved by decoupling each of the twodimensional transport equations into a series of one-dimensional equations. This decoupling should easily allow for extension of the model to three dimensions. An iterative solution was adopted bedimensions. An iterative solution was adopted be-cause a purely sequential technique had been ob-served to greatly underestimate the dissolved mass of an organic plume. Comparison of numerical results with the results of a laboratory column experiment showed that the model equations adeexperiment shower that the model equations auc-quately describe the behavior of foluene, dissolved oxygen, and the bacterial population, without con-sidering solute diffusion through stagnant fluid layers or biofilms. In a two-dimensional shallow layers or biofilms. In a two-dimensional shallow aquifer setting an organic plume experiences mass loss, spreading controlled by the availability of dissolved oxygen, and skewing in the direction of groundwater flow. These features would be lost if the interactions between the organic contaminant, electron acceptor, and microbial population were ignored in the mathematical formulation of the problem. (See also W90-07352) (Author's abstract) W90-07351

SIMULATION OF BIODEGRADABLE ORGAN-IC CONTAMINANTS IN GROUNDWATER: 2.
PLUME BEHAVIOR IN UNIFORM AND
RANDOM FLOW FIELDS.

Waterloo Univ. (Ontario). Inst. for Ground Water Research.

K. T. B. MacQuarrie, and E. A. Sudicky.
Water Resources Research WRERAQ, Vol. 26,
No. 2, p 223-239, February 1990. 25 fig, 24 ref.
University Research Fellowship Grant U0508.

Descriptors: "Fate of pollutants, "Groundwater pollution, "Model studies, "Organic compounds, "Path of pollutants, "Plumes, Biodegradation, Dissolved organic carbon, Dissolved oxygen, Groundwater movement, Hydrologic models, Mathematical models, Microorganisms, Numerical analysis, Simulation analysis, Sorption.

The behavior of dissolved organic contaminants in groundwater is often difficult to interpret in field settings. The organic solute transport model of MacQuarrie and coworkers was used to examine plume migration in a shallow aquifer where displume migration in a snallow aquiter where dis-solved oxygen was the sole electron acceptor. In uniform groundwater flow a plume originating from a high-concentration source will experience more spreading and lower normalized mass loss than a plume from a lower initial concentration source because dissolved oxygen is depleted more quickly. Low background dissolved oxygen concentrations also cause organic mass loss to de-crease, whereas the initial size of the microbial population has little effect. Large groundwater ve-locities produce increases in the rate of organic solute mass loss because of increased mechanical mixing of the organic plume with oxygenated groundwater. Because sorbed organic mass is unailable for biodegradation, increasing the retardation factor of an organic solute causes slower mass loss. For easily biodegraded organics the mass loss depends only weakly on the kinetic biodegradation parameters because the amount of mixing of the organic and the dissolved oxygen controls the biodegradation process. This implies that, for these types of compounds, the kinetic parameters do not need to be known with precision. For all simulations the rate of mass loss for the organic plumes decreased with time because the organic plumes decreased with time because the concentrations of organic and dissolved oxygen decreased with time. In complex-structured flow fields caused by heterogeneity, the bulk velocity, position, and rate of spreading of an organic plume depends strongly on local-scale transport parameters such as the groundwater velocity in individual beds. Because an organic plume emanating from a small to moderate sized source does not evolve in a manager similar to a conservative plume; in heterogeneous similar to a conservative plume in heterogeneous materials due to a decrease in the size of the plume, it is suggested that average transport parameters such as macrodispersivity may not apply to such organic plume transport. (See also W90-07351) (Author's abstract) W90-07352

CONTINUOUS-TIME INVERSE OPERATOR FOR GROUNDWATER AND CONTAMINANT TRANSPORT MODELING: DETERMINISTIC

Purdue Univ., Lafayette, IN. School of Civil Engi-

T. R. Ginn, J. H. Cushman, and M. H. Houck. Water Resources Research WRERAQ, Vol. 26, No. 2, p 241-252, February 1990. 4 fig, 34 ref.

Descriptors: *Dispersion, *Groundwater pollution, *Model studies, *Path of pollutants, *Solute transport, Groundwater movement, Laplace equation, Mathematical studies, Numerical models, Reviews.

The value of time-dependent data in the calibration of numerical models of groundwater flow has been highlighted in recent literature. Here the backnigning ted in recent interature. Here the back-ground for a new development in the inverse prob-lem is established, and a new operator for inversion of the spatially discretized diffusion equation is introduced. The motivation for the development of an inverse problem solution procedure that uses information in transient data is illustrated with a focused review of recent literature. An approach tocused review of recent interature. An approach that implicitly incorporates the continuous time dependency of the flow model is presented. This approach is based on the new concept of inverting the model after the (for example) spatial discretization, but before the (typically) finite difference temporal discretization of the model rather than afterward as has been done in the past. The Laarterward as nas open done in the past. The Laplace transform is used to replace discretization in time of the system of ordinary differential equations to discretization in the Laplace variable of the algebraic system in Laplace space. The existence of the deterministic solution in the Laplace ence of the deterministic solution in the Laplace transform space does not require knowledge of the eigenvalues of the diffusion matrix but only the specification of the Laplace variables near zero. A simple numerical example from the literature is used to generate a set of three simplified test cases upon which the proposed method is tested. It is concluded that a new method exists for the direct inversion of numerical groundwater models and other diffusion models (e.g., the convection-dispersion model) that is designed specifically to incorporate transient head data. (Author's abstract)

ANALYSIS OF SOLUTE REDISTRIBUTION IN

AHALISIS OF SOLUTE REDISTRIBUTION IN A HETEROGENEOUS FIELD. Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition.

S. E. A. T. M. van der Zee. Water Resources Research WRERAQ, Vol. 26, No. 2, p 273-278, February 1990. 4 fig, 26 ref, 2

Descriptors: *Path of pollutants, *Soil contamina-tion, *Soil water, *Solute transport, Isotherms, Mathematical analysis, Porous media, Sensitivity analysis. Simulation.

The redistribution of a solute present in the topsoil is simulated assuming adsorption according to the Langmuir isotherm. A parameter sensitivity analysis showed that the effect of the thickness of the initial solute-containing layer on the concentration distribution can be accounted for by transforming time. Both this thickness and adsorption parameters control how rapidly the concentration decreases in the topsoil, when the feed concentration does not contain solute. At larse times the concencreases in the topsoil, when the feet concentration does not contain solute. At large times the concentration increases gradually to the penetration depth, which is the mean downstream front position. There the concentration decreases rapidly to the initial value in the subsoil. When randomness of the thickness and adsorption parameters is con-sidered, no such well-defined subsoil front is seen. With a simple approximation valid for a constant feed concentration larger than zero and for linear adsorption, it is shown when pore scale dispersion may be discarded. (Author's abstract) W90-07356

COLLOID MOBILIZATION IN TWO ATLAN-TIC COASTAL PLAIN AQUIFERS: FIELD STUDIES.

Massachusetts Inst. of Tech., Cambridge. Ralph M.

Sources Of Pollution—Group 5B

Parsons Lab.
J. N. Ryan, and P. M. Gschwend.
Water Resources Research WRERAQ, Vol. 26,
No. 2, p 307-32, February 1990. 7 fig, 4 tab, 84
ref. DOE Contract DE-FG02-86ER60413.

Descriptors: *Aquifers, *Coastal plains, *Colloids, *Geochemistry, *Path of pollutants, Aluminum, Clays, Delaware, Dissolved oxygen, Electron microscopy, Electrophoresis, Iron, New Jersey, Organic carbon, Photometry, Pine Barrens, Silicon, X-ray analysis.

X-ray analysis.

The geochemical mechanisms leading to the mobilization of colloids in groundwater were investigated in the Pine Barrens of New Jersey and in rural central Delaware by sampling pairs of wells screened in oxic and anoxic groundwaters in the same geologic formations. Samples were taken carefully at very low flow rates (about 100 ml/min) to avoid suspending immobilized particles. The colloidal matter was characterized by light-scattering photometry, scanning electron microscopy, energy-dispersive X-ray analysis, microelectrophoresis, and Fe, Al, Si, and organic carbon analyses. The colloids, composed primarily of clays, were observed at high concentrations (up to 60 mg/L colloids) in the anoxic groundwaters, whereas the oxic groundwaters exhibited 1 mg/L colloids or less. Colloidal organic carbon was present in all groundwaters, but under anoxic conditions one-third to one-half of the total organic carbon was associated with inorganic colloids. The field evidence indicates that anoxic conditions cause mobilization of soil colloids by dissolving the ferric oxyhydroxide coatings cementing the clay particles to the aquifer solids. The depletion of oxidized iron on the surfaces of immobile particles and the addition of organic carbon coatings on the soil particles and colloids apparently stabilizes the colloidal suspension in the anoxic groundwaters. (Author's abstract) W90-07359

FIRST- AND THIRD-TYPE BOUNDARY CONDITIONS IN TWO-DIMENSIONAL SOLUTE TRANSPORT MODELING.

International Technology Corp., Monroeville, PA. V. Batu, and M. T. van Genuchten. Water Resources Research WRERAQ, Vol. 26, No. 2, p 339-350, February 1990. 8 fig, 23 ref, 2 append.

Descriptors: *Groundwater movement, *Mathematical studies, *Model studies, *Solute transport, Boundary conditions, Errors, Numerical analysis, Porous media

A general analytical solution is presented for convective-dispersive solute transport in a two-dimensional, semiinfinite porous medium. The solute is assumed to be subject to linear equilibrium sorption and first-order decay. Solutions are derived for several third-type (Cauchy) or flux-type boundary conditions at the input surface. Both a general yapplicable solution and a special solution for a strip-type solute source were developed. The third-type boundary condition correctly conserves mass in the two-dimensional system and the first-order (Drichlet) or concentration-type boundary condition corresponds to a situation in which the solute flux at the source decreases with time and at large time approaches the solute flux of the third-type boundary condition. This can lead to significant discrepancies in the calculated concentrations, especially near the source boundaries. (Author's abstract)

BANNING TRICHLOROETHYLENE: RE-SPONSIBLE REACTION OR OVERKILL. Oregon State Univ., Corvallis. Dept. of Civil Engineering.

neering.
For primary bibliographic entry see Field 5G.
W90-07364

BIODEGRADATION EXPERIMENTS OF LINEAR ALKYLBENZENES (LABS): ISOMER-IC COMPOSITION OF C12 LABS AS AN INDI-CATOR OF THE DEGREE OF LAB DEGRADA-TION IN THE AQUATIC ENVIRONMENT.

Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.

Chemistry.

H. Takada, and R. Ishiwatari.

Environmental Science and Technology

ESTHAG, Vol. 24, No. 1, p 86-91, January 1990. 4

fig, 3 tab, 16 ref. Ministry of Education, Science
and Culture, Japan Grants 58030062, 59030064,
and 6103005. Tokyu Foundation for the Better

Environment Grant 5724.

Descriptors: *Benzenes, *Biodegradation, *Fate of pollutants, *Microbial degradation, Domestic wastes, Isomers, Marine sediments, Surfactants, Tracers.

Laboratory incubations of linear alkylbenzenes (LABs), potential molecular tracers of domestic surfactant wastes, were conducted to obtain experimental evidence of systematic microbial alteration of their isomeric composition. Untreated wastewater samples from a representative treatment plant in Tokyo were incubated under aerobic conditions with constant mixing in sample bottles for periods lasting up to 32 days at 13-28 C. An anaerobic incubation was also conducted for 6 days. LABs were analyzed in periodic samples of the incubations by gas chromatography. The results showed that external LAB isomers (E) are more rapidly biodegraded than internal LAB isomers (I). The degree of LAB degradation was found to be quantitatively related to the change in their isomeric composition. The isomeric composition, represented by I/E ratio, is proposed as an indicator of LAB degradation. The I/E ratio was applied to estimate the persistence of LABs around Tokyo. The results indicate that the degree of LAB degradation in estuarine and bay sediments is approximately 45%. (Geiger-PTT)

TRANSFORMATIONS OF SELENIUM AS AF-FECTED BY SEDIMENT OXIDATION-REDUC-TION POTENTIAL AND PH.

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.

P. H. Masscheleyn, R. D. Delaune, and W. H. Patrick.

Environmental Science and Technology ESTHAG, Vol. 24, No. 1, p 91-96, January 1990. 4 fig, 3 tab, 28 ref.

Descriptors: "Hydrogen ion concentration, "Kesterson Reservoir, "Oxidation-reduction potential," and of pollutants, "Selenium, "Solubility, Dissolved solids, Fate of pollutants, Iron, Oxidation, Speciation, Volatility.

The influence of redox potential (Eh) and pH on selenium solubility, speciation, and volatilization was studied. Kesterson Reservoir sediments contaminated with selenium were incubated under controlled redox (-200, 0, 200, and 450 millivolts) and pH (6.5, natural, 8.5, and 9) conditions. Under reduced conditions selenium solubility was low and controlled by an iron selenide phase. Sec-II,0) comprised 80-100% of the total soluble selenium. Upon oxidation dissolved selenium concentrations increased. The oxidation of Sec-II,0) to selenite was rapid and occurred immediately after the oxidation of iron. Above 200 millivolts selenite slowly oxidized to selenate. Under oxidized conditions (450 millivolts) selenium solubility reached a maximum. Selenate was the predominant dissolved species present, constituting 95% at higher pH's (8.9, 9) to 75% at lower pH's (7.5, 6.5) of the total soluble selenium at 450 millivolts. Biomethylation of selenium occurred only under oxidized conditions. Redox potential and pH are key factors in the biogeochemistry of selenium. (Author's abstract)

DISTRIBUTION AND MOBILIZATION OF AR-SENIC AND ANTIMONY SPECIES IN THE COEUR D'ALENE RIVER, IDAHO.

Idaho Univ., Moscow. Dept. of Chemistry. W. M. Mok, and C. M. Wai. Environmental Science and Technology ESTHAG, Vol. 24, No. 1, p 102-108, January 1990. 5 fig, 8 tab, 21 ref.

Descriptors: *Antimony, *Arsenic, *Fluvial sediments, *Idaho, *Mine drainage, *Path of pollutants, Hydrogen ion concentration, Leaching, Sediment transport. Spatial distribution.

Sediments from the Main Stem and the South Fork of the Coeur d'Alene River are contaminated with arsenic (As), antimony (Sb), and other heavy metals from the local mining operations. Water samples from the South Fork and the Main Stem showed high levels of As (0.11-1.64 micrograms/L) and Sb (0.23-8.25 micrograms/L) relative to those from the North Fork (0.26 micrograms/L As and 0.17 micrograms/L Xb). Arsenic(III) was the predominant form in the waters of the South Fork and Main Stem of the Cocur d'Alene River, whereas the North Fork generally had higher As(V) concentrations. The major inorganic Sb species was Sb(V) in all three branches of the river. Leaching of As and Sb species from the contaminated Main Stem sediments depends on the pH values of the water as well as on the free iron oxides and manganese oxides present in the sediments. Mobilization of As and Sb was more likely to occur in sediments low in iron oxides and manganese oxides. As and Sb solubility was enhanced at both a low and a high pH. Since lime treatment is a common method used to deal with acid mine drainage and wastewaters related to mine tailings, the discharge of lime-treated wastewater with high pH might result in a higher As and Sb release from the sediment in contact. A near-neutral pH condition would favor the long-term stability of mine wastes with respect to As and Sb. The leaching of As and Sb from river sediments into the water is more pronounced at low flow. Acid precipitation is also an important factor affecting As and Sb mobility in surface water. (Geiger-PTT)

CHEMISTRY OF MUTAGENIC BY-PROD-UCTS OF WATER CHLORINATION. North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering. For primary bibliographic entry see Field 5F. W90-07373

FORMATION OF CHLORINATED PAH: A POSSIBLE HEALTH HAZARD FROM WATER CHLORINATION.

Institutt for Kontinentalsokkelundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). For primary bibliographic entry see Field 5F. W90-07374

NATURALLY PRODUCED ADSORBABLE OR-GANIC HALOGENS (AOX) IN HUMIC SUB-STANCES FROM SOIL AND WATER. Linkoeping Univ. (Sweden). Dept. of Water and Environmental Research. For primary bibliographic entry see Field 2K. W90-07375

HUMIC-LIKE SUBSTANCES FROM LAND-FILL LEACHATES: CHARACTERIZATION AND COMPARISON WITH TERRESTRIAL AND AQUATIC HUMIC SUBSTANCES.

Karlsruhe Univ. (Germany, F.R.). Engler-Bunte

M. Weis, G. Abbt-Braun, and F. H. Frimmel. Science of the Total Environment STENDL, Vol. 81/82, p 343-352, June 1989. 3 fig, 4 tab, 21 ref. Deutsche Forschungsgemeinschaft Bonn-Bad Godesberg Grant FR536/6 and FR 536/9.

Descriptors: *Chemical properties, *Humic substances, *Landfills, *Leachates, *Organic acids, Bogs, Copper, Hydrogen, Lakes, Organic carbon, Phenols, Pollutant identification, Soil water, Sulfur, Water analysis.

Terrestrial and aquatic humic substances were compared with humic like substances in seepage water from landfills by spectro.copy, elemental analysis, acid base titration, polarography and gel chromatography. XAD-isolated fractions of organic acids from landfill leachates and those from soil and bog lake water showed similarities: yellow-

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brown color, acidic functionality of several micro-moles/mg dissolved organic carbon and high mo-lecular weight. The humic-like substances isolated lecular weight. The humic-like substances isolated from the seepage water of the dumping areas, however, had higher carbon-, hydrogen-, and sulfur-content, lower quantities of phenolic groups, lower complexation capacities for copper and lower molecular weight. Organic acids from anaer-chic necessary water seed to recreate a necessary to be consequent to the content of the conte obic scepage water seemed to represent an early stage in the genesis of humic substances. (Geiger-PTT) W90-07385

EFFECT OF THE APPLICATION OF A MU-NICIPAL REFUSE COMPOST ON THE PHYSI-AND CHEMICAL PROPERTIES OF A SOIL

Instituto de Edafologia y Biologia Vegetal, Madrid (Spain).

For primary bibliographic entry see Field 5E. W90-07388

ROLE OF FOREST CANOPIES IN THE COL-LECTION AND NEUTRALIZATION OF AIR-

LECTION AND NEUTRALIZATION OF AIR-BORNE ACID SUBSTANCES.
Tokyo Inst. of Tech. (Japan). Dept. of Environ-mental Chemistry and Engineering.
S. Yoshida, and M. Ichikuni.

Science of the Total Environment STENDL, Vol. 84, p 35-43, August 1989. 2 fig, 4 tab, 23 ref.

Descriptors: *Acid rain, *Air pollution, *Canopy, *Forests, *Interception, *Path of pollutants, Alu-minum, Anions, Cation exchange, Cations, Leach-ing, Leaves, Neutralization, Throughfall.

The role of the canopy in the collection of air-borne acid substances and in the neutralization of the acids by cation exchange processes were stud-ied in three different types of forests in the subur-ban area of Yokohama. Bulk throughfall collected ban area of Yokonama. Bulk throughtail collected in the forest and bulk precipitation collected in the open field outside of the forest were analyzed for Ca(++), Mg(++), K(+), Na(+), NH4(+), H(+), Ci(-), NO3(-), SO4(-), and AI. For almost all components, bulk throughfall exceeded bulk all components, bulk throughfall exceeded bulk precipitation in elemental flux, owing to interception deposition and canopy leaching. Only the H(+) flux decreased during passage of precipitation through the canopy. Canopy leaching of Ca(++), Mg(++), and K(+) was determined by assuming that Ca(++)/Al, Mg(++)/Al, or K(+)/Al ratios in interception deposition are equal to the corresponding ratios in bulk precipitation. Total acid deposition to the forest, assumed to be equal to the throughfall fluxes of SO4(-) and NO3(-), exceeded the flux of acid substances (H + NH4(+)) in bulk precipitation by factors of 1.7, 2.0, and 2.5 for Japanese deciduous oak forest, Japanese cedar Japanese evergreen oak forest, and Japanese cedar forest, respectively, indicating the importance of interception deposition of acid substances to the canopy. From 49 to 74% of total acid deposition was neutralized at the canopy. A major part of the neutralization was attributable to the cation exchange processes at the canopy surface. Evidently the processes depend on the nature and form of the leaf surface. (Author's abstract)

RATIONAL APPROACH TO THE ASSESS-MENT OF ALUMINIUM SOLUBILITY CON-TROLS IN FRESHWATERS.

Senter for Industriforskining, Oslo (Norway).

N. Christophersen, and C. Neal.

Science of the Total Environment STENDL, Vol.

84, p 91-100, August 1989. 1 fig, 3 tab, 16 ref.

Descriptors: *Acid rain, *Aluminum, *Aquatic environment, *Path of pollutants, *Statistical analysis, *Thermodynamics, *Water chemistry, Data interpretation, Freshwater, Regression analysis, Soil water, Solubility, Temperature effects.

The problem of assessing aluminum equilibrium solubility controls in freshwaters using thermodynamic techniques is placed in a statistical hypothesis testing framework. As an aid in interpreting field information, artificial data are generated which correspond to ideal equilibrium conditions,

but which incorporate realistic analytical and tem-perature related uncertainties. These artificial data are then subjected to thermodynamic interpreta-tions. The technique is useful in answering hypothetical questions by showing the scatter to be expected in real data under true equilibrium conditions. Aluminum hydroxide is used as the example tions. Aluminum hydroxide is used as the example in this report. Reasons for discarding the conventional dependent axis plot (pAl(+3) vs pH) in favor of a plot with independent or nearly independent axes are emphasized. An improved method is suggested allowing for temperature variations in the equilibrium constants when constructing stability diagrams. Also, there is need for cau-tion when regressing variables which both contain errors. (Author's abstract)

HEAVY METAL POLLUTION INDUCED BY A FERRO-NICKEL SMELTING PLANT IN

GREECE. Athens Univ. (Greece). Zoological Lab. and

Museum.
A. Nicolaidou, and J. A. Nott.
Science of the Total Environment STENDL, Vol.
84, p. 113-117, August 1989. 2 tab, 8 ref. EEC
Twinning Grant STJ-0046-01/2-UK/GR.

Descriptors: *Greece, *Heavy metals, *Industrial wastes, *Invertebrates, *Marine plants, *Marine pollution, *Marine sediments, *Path of pollutants, Chromium, Cobalt, Copper, Iron, Manganese,

Seven heavy metals, Co, Cr, Cu, Fe, Mn, Ni and Zn, were measured in marine sediments, plants and invertebrates in the vicinity of a ferro-nickel smelting plant in Greece. The concentrations of metals in the sediment were higher than those found in e sediment were higher than those found in the average unpolluted Greek coastal sediment. The concentrations of metals varied in the different species of invertebrates. The gastropod mollusks tended to concentrate the metals more than the bivalve mollusks. Cerithium vulgatum showed particularly high concentrations of Co, Mn, Ni and Zn. The cone shell Conus mediterraneus had the highest concentration of Cu together with the winkles Monodonta spp., which also showed high concentrations of Cr. The relatively low concen-trations of metals in the filter feeders and the high concentrations in the herbivores and detritus feeders suggest that one pathway for the metals may be through the plants, some of which also show high oncentrations. (Geiger-PTT) V90-07392

MERCURY LEVELS IN TOTAL SUSPENDED MATTER AND IN PLANKTON OF THE MEDI-TERRANEAN BASIN.

Istituto di Biofisica, Pisa (Italy).

R. Ferrara, B. E. Maserti, and C. Zanaboni Science of the Total Environment STENDL, Vol. 84, p 129-134, August 1989. 3 fig, 1 tab, 18 ref.

Descriptors: *Mediterranean Sea, *Mercury, *Particulate matter, *Path of pollutants, *Plankton, *Suspended solids, Adsorption, Bioaccumulation, Turbidity.

Mercury levels in total suspended matter (TSM) and in plankton of sea water from some Mediterra-nean areas were determined by atomic fluorescence spectrometry. The mercury concentration in TSM collected with a filter of 0.45 micron pore TSM collected with a filter of 0.45 micron pore size ranged from 0.1 to 2.4 nanograms/L and from 0.1 to 4.7 nanograms/L and from 0.1 to 4.7 nanograms/milligram dry weight. These levels were 3-10 times higher than those observed in plankton (0.08-0.29 nanograms/milligram dry weight) collected with a 200 micron net mesh size. No variation of mercury concentration with depth was noted, with the exception of the upper layer, where an increase in metal concentration was observed at depths of 0-100 m. The highest mercury concentrations in 1 milligram TSM (dry weight) were observed in the Alboran and Balearic Seas, where the waters were particularly clear, as shown were observed in the Alboran and Baleanc Seas, where the waters were particularly clear, as shown by low turbidity values. The highest TSM values were observed in the Tuscan Archipelago, an area close to the coast. The higher mercury concentrations in TSM than in plankton were attributed to the retention on the filter of small-sized particles

and the possible presence of cinnabar particles as a consequence of the geological nature of the Mediterranean Basin. (Geiger-PTT)

TRACE METALS IN SEDIMENTS FROM THE ADRIATIC SEA.
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
Center for Marine Research.

D. Martincic, Z. Kwokal, M. Stoeppler, and M.

Branica. Science of the Total Environment STENDL, Vol. 84, p 135-147, August 1989. 3 fig, 1 tab, 39 ref.

Descriptors: *Adriatic Sea, *Lead, *Marine pollu-tion, *Marine sediments, *Path of pollutants, *Trace metals, Cadmium, Copper, Heavy metals, Mercury, Water pollution sources, Zinc.

Concentrations of trace metals were determined in Concentrations of trace metals were determined in sediments (grain-size fraction < 75 microns) from different parts of the Adriatic Sea. The results were compared with data obtained in sediments of similar granular composition by other authors con-cerned with pollution problems in the Adriatic Sea. Sediments were collected from unpolluted Sea. Sediments were collected from unpolluted marine and estuarine areas, and from areas under direct anthropogenic influence and were analyzed for Cd, Pb and Cu by electrothermal atomic aborption spectrophotometry, for Zn by flame technique, and for Hg by a cold-vapor method accumulating the metal on a gold wire. The concentrations of Zn, Cd, Hg, and Cu were comparable to the lowest values so far reported for sediments from the Adriatic Sea, showing that solid phases of the Adriatic Sea, with the exception of those in restricted localities under direct anthropogenic influence, had concentrations similar to those in unpolluted marine and estuarine sediments. Lead concentrations in sediments from the north Adriatic polluted marine and estuarine sediments. Lead concentrations in sediments from the north Adriatic and along the coast of the central and south Adriatic Sea were a factor of two higher than those obtained from the same locations in 1976. Such an enrichment of the bottom deposits with Pb was attributed to the high frequency of ships passing along the coast using leaded gasoline. The distribution of all metals studied was strongly dependent upon the grain-size fraction (< 20 microns) of the whole sediment. (Geiger-PTT) W90-07394

RADIONUCLIDES IN SHORELINE WATERS OF THE NORTHEAST IRISH SEA.

UKAEA Atomic Energy Research Establishment, Harwell (England). Environmental and Medical

W. A. McKay, and N. J. Pattenden. Science of the Total Environment STENDL, Vol. 84, p 159-167, August 1989. 1 fig, 6 tab, 19 ref.

Descriptors: "Aluminum, "Americium radioisotopes, "Cesium radioisotopes, "Coastal waters, SIrish Sea, "Marine pollution, "Path of pollutants, "Plutonium radioisotopes, "Radioactive wastes, "Water pollution sources, Mollusks, Seawater, Suspended solids.

The shoreline waters of the Irish Sea along the Cumbrian coast near the British Nuclear Fuels plc works at Sellafield were sampled at three locations over a 3.5 yr period from December 1980. The particulate content was analyzed for Pu238, Pu239+240, Am241, Cs137 and stable Al. In some Pu239+240, Am241, Cs137 and stable Al. In some cases the radionuclide concentrations in filtered seawater were also determined. The results showed that the suspended particulate loads were high (typically about 100 milligrams/L) and variable, and that they contained about 65 milligrams/gm of Al. The isotopic ratio Pu238/Pu239+240, which can indicate the chronology of the discharge, was about 0.26, which suggested that the Sellafield discharges over at least 5 yr contributed to the observed concentrations. The Pu239+240. Senianed discinarges over at least 3 yr contributed to the observed concentrations. The Pu239+240 and Am241 annual average concentrations in the particulate material were in the ranges 3.0-5.1 and 3.3-5.2 Bq/gm, respectively. The individual values were very variable in time, but highly correlated with each other. No significant downward trends in the concentrations could be identified over this period. This is consistent with the behavior of a

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reservoir (the northeast Irish Sea) where Pu and Am, which are available for suspension in particu-late material, are fed by the Sellafield discharges and are subject to a mean removal time of several yr. Thus the effects of the large reduction in the Sellafield discharges which occurred over this period should only be observable over a longer time interval. The concentration: time interval. The concentrations in the dissolved fractions in seawater were negligible compared rractions in seawater were negligine compared with the particulate fraction concentrations, in sharp contrast with the situation in offshore seawater. For Cs137, the annual average concentration in filtered seawater was in the range 7.6-12.0 tion in filtered seawater was in the range 7.6-12.0 Bq/L, which was 87-90% of the total concentration in seawater, proportions rather lower than some results reported in the 1970s, possibly reflecting a residual effect of the higher discharges. In general, the work showed that measurements of shoreline seawater are necessary in order to interpret littoral effects such as the sea-to-land transfer of radionuclides and the uptake of radionuclides by mollusks, in the environment of the Irish Sea. (Author's abstract)
W90-07395

GROUNDWATER POLLUTION BY MANGA-NESE: MANGANESE SPECIATION-APPLICA-TION TO THE SELECTION AND DISCUSSION OF AN IN SITU GROUNDWATER TREAT-MENT.

MENT. Aix-Marseille-1 Univ. (France). Lab. Chimie et Environnement. P. Jaudon, C. Massiani, J. Galean, and J. Rey. Science of the Total Environment STENDL, Vol. 84, p 169-183, August 1989. 4 fig, 6 tab, 24 ref.

Descriptors: *Groundwater pollution, *Manga-nese, *Water pollution sources, *Water pollution treatment, Anaerobic bacteria, Aquifers, Biodegra-dation, Chemical speciation, Dissolved oxygen, Drinking water, Iron, Model studies, Oxidation-reduction potential, Oxygenation.

Drinking water pumped into an alluvial water table frequently becomes progressively polluted by dissolved manganese and iron, causing problems for regulatory authorities. Manganese speciation and bacteriological experiments are essential to determine the origin of the manganese and the processes of water pollution in order to select the most appropriate treatment. In an aquifer which was an alluvial water table of the River Rhone supplying drinking water for the city of Beaucaire, speciation and mineralogical results showed that manganese originates from within the aquifer itself. anganese originates from within the aquifer itself, ainly in the form of oxides (Z-disordered mangamannly in the form of oxuces (2-disordered manga-nate type, 10 angstroms manganate, todorokite, birnessite) which settle on components of the pebble bed forming the aquifer. Manganese release is due to a decrease of dissolved oxygen in the groundwater. Under these conditions, Mn(IV) is reduced both chemically and bacterially into the Mn(II) soluble form. In such situations an in situ water treatment consisting of the oxygenation of the aquifer has proved to be both suitable and inexpensive in controlling Mn pollution. The risks of aquifer contamination by Mn were greater when bacterial cultures were reduced and when dissolved oxygen concentrations were low, suggestations that the content of th solved oxygen concentrations were low, suggesting the importance of oxidizing bacteria in the control of Mn levels. The facultative anaerobic bacteria of the aquifer use the metallic oxides as final acceptors of electrons, leading to the dissolution of iron and manganese. The oxygen supplied by the Vyredox process stops the release of Mn, both by a redox increase and through a modification of bacterial respiration: the bacteria readily use the dissolved oxygen molecules. When the metallic oxides remain on the pebble beds in the aquifer, the risk of pores becoming filled is reduced in the oxidizing zone. (Geiger-PTT) W90-07396

SPECIATION OF IONIC ALKYLLEAD IN PO-TABLE WATER AND SOIL.

Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

istry.
D. Chakraborti, W. Dirkx, R. Van Cleuvenbergen,

and F. Adams.
Science of the Total Environment STENDL, Vol. 84, p 249-257, August 1989. 3 fig, 3 tab, 20 ref.

Descriptors: *Lead, *Path of pollutants, *Potable water, *Soil contamination, *Water pollution sources, Chemical speciation, Degradation, Groundwater pollution, Highway effects, Trace

Various potable water and soil samples were analyzed for tri-alkyllead and dialkyllead compounds lyzed for tri-alkyllead and dialkyllead compounds using a sensitive speciation procedure based on diethyldithiocarbamate extraction, Grignard derivatization and gas chromatography-atomic absorption spectrometry. The species are generally present as ultra-trace contaminants ranging in concentration from 0.35 to 9.27 nanograms/L for total ionic alkyllead in the potable water samples and from 0.33 to 1.07 nanograms/gm for total ionic alkyllead in the soil samples studied. A preliminary degradation study was performed by regular extensions. degradation study was performed by regular ex-traction and gas chromatography-atomic absorp-tion spectrometry analysis of stored samples of road runoff water, soil and road dust. In general, the concentration of the most abundant species, an the concentration of the most abundant species, an ethyllead compound, decreased most rapidly. Methyllead products, particularly trimethyllead, appeared to be the most stable: this species re-mained almost unchanged for 2 months under the conditions of the experiment. There was no evidence that lead-containing products other than inorganic lead were formed during long-term storage. In road runoff water, the diethyllead profile initially did not demonstrate the pronounced de-crease as in the other samples suggesting a contri-bution from triethyllead decomposition. (Geiger-PTT) W90-07398

MUTAGENIC ACTIVITY AND PRESENCE OF THE STRONG MUTAGEN 3-CHLORO-4-THE STRONG MUTAGEN 3-CHLORO-4(DICHLOROMETHYL)-5-HYDROXY-2-(5H)FURANONE (MX) IN CHLORINATED RAW
AND DRINKING WATERS IN THE NETHER-

Abo Akademi, Turku (Finland). Dept. of Organic Chemistry.
For primary bibliographic entry see Field 5C.
W90-07400

MODELING SOLUTE TRANSPORT IN SOILS IN THE PRESENCE OF DISSOLVED HUMIC SUBSTANCES.
Institut National de la Recherche Scientifique,

Sainte-Foy (Quebec). P. Lafrance, O. Banton, P. G. C. Campbell, and J.

P Villeneuve Science of the Total Environment STENDL, Vol. 86, No. 3, p 207-221, October 1989. 8 fig, 1 tab, 34

Descriptors: *Humic substances, *Model studies, *Path of pollutants, *Soil chemistry, *Soil contamination, *Soilut chransport, *Sorption, Dissolved solids, Finite difference methods, Kinetics, Organic matter, Sensitivity analysis, Simulation analysis, Soil water.

Several studies concerning the effects of humic materials on the aqueous behavior of some hydro-phobic contaminants have demonstrated that natural organic matter found in ground and surface waters can bind these contaminants and possibly affect their transport in the environment. The moaffect their transport in the environment. The mis-bility of trace organic contaminants in soil, origi-nating from non-point source pollution, may thus be affected by the presence of dissolved organic matter, either in the unsaturated or in the saturated zone of the soil. In order to predict the possible importance of such interactions, simulations were made using a three-site sorption model to describe contaminant retention in soil. Two kinetic rate equations and an equilibrium Freundlich equation were used to describe adsorption-desorption of two species of the contaminant (free or bound with olved organic matter) in a soil-water system. The equations governing the contaminant adsorp-tion and the transport are simultaneously solved using an explicit-implicit finite difference technique, under steady-state water flow conditions. This conceptual mode describes the effluent concentrations of a contaminant from a saturated soil column, assuming complexation of a fraction of the contaminant and possible adsorption of this com-

plex on the soil matrix. A sensitivity analysis of the model to variations in the constant of complexation model to variations in the constant of complexation and in the sorption rate constants showed the relative importance of these processes and their effects on the vertical movement of the contaminant in the soil. These effects are predicted to be significant under conditions that can occur in a soil-water system. (Author's abstract) W90-07401

INFLUENCE OF VENICE LAGOON MACRO-FAUNA ON NUTRIENT EXCHANGE AT THE SEDIMENT-WATER INTERFACE.

Venice Univ. (Italy). Dept. of Environmental Sci-

For primary bibliographic entry see Field 2L. W90-07402

ORGANOCHLORINE COMPOUNDS AND PCB CONGENERS IN CONTAMINATED SEDI-MENTS

Commission of the European Communities, Ispra (Italy). Radiochemistry and Nuclear Chemistry

B. Larsen, and K. Fytianos. Science of the Total Environment STENDL, Vol. 86, No. 3, p 273-279, October 1989. 1 fig. 1 tab, 24

Descriptors: *Chlorinated hydrocarbons, *Fluvial sediments, *Marine sediments, *Polychlorinated biphenyls, *Sediment contamination, *Water pollution sources, Benzenes, Greece, Halogenated pesticides, Marine pollution, Path of pollutants.

Residue levels of organochlorine compounds and polychlorinated biphenyls (PCB) congeners in sur-face sediments of two rivers and the Thermaikos Gulf of northern Greece were determined by gas chromatography with electron capture detection.
Considerable variations between PCB congeners Considerable variations between PCB congeners were observed for most of the samples; various chlorobenzenes showed the same patterns as the PCBs, indicating a common pollution source. The concentrations of organochlorine pesticides and PCBs were compared with those reported in the literature and were similar to those found for slightly polluted areas. The highest levels of these compounds were found in the Thermaikos Gulf, where the untreated municipal swage of the city. where the untreated municipal sewage of the city of Thessaloniki is discharged. (Author's abstract) W90-07403

COLUMN LEACHING OF UNRETORTED AND RETORTED OIL SHALES AND CLAYSTONES FROM THE RUNDLE DEPOSIT: WATER LEACHING.

LEACHING.
Commonwealth Scientific and Industrial Research
Organization, North Ryde (Australia). Div. of
Coal Technology.
D. R. Jones, B. M. Chapman, and R. F. Jung.
Water Research WATRAG, Vol. 24, No. 2, p 131141, February 1990. 6 fig, 7 tab, 30 ref.

Descriptors: *Australia, *Claystones, *Leachates, *Oil shale, *Solid wastes, *Water pollution sources, *Waste dumps, Rundle oil shale deposit, Chemical composition, Manganese, Nitrate, Molybdenum, Arsenic, Selenium, Boron, Thiosulfate, Conner Nickel.

The chemical compositions were determined for leachates from both small and large columns conleachates from both small and large columns con-taining a number of solid wastes components likely to be present in the dumps of a future shale oil industry on the site of the Rundle oil shale deposit which is located on the central Queensland coast of Australia. Samples of unretorted and retorted shales and interburden claystone from two of the major seams (called the Kerosene Ck and lower major seams (cauled the kerosene Cx and lower Ramsay Crossing seams) were used for this study. These materials were leached both individually and in admixture under unsaturated flow condi-tions with distilled water. Long term trends in leachate composition were obtained by maintaining each of the columns for at least one year. A number of components in the first pore volume of leachate from some of the columns were found to exceed Australian drinking water and irrigation

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water criteria. These were Mn, NO3, Mo, As, Se and B. Thiosulfate was present in high concentrations in the leachate from retorted shale. Almost 50% of the Cu and Ni leached from the Kerosene Ck shale was present in the form of metallo-organic complexes. The composition of leachates in the first pore volume from both the small and large first pore volume from both the small and inter-columns was found to be the same, indicating that the results of small scale column test may provide a good model for the leaching of the actual waste dumps to be constructed at Rundle. (Author's abstract) W90-07414

CHEMICAL CHARACTERISTICS OF A MEDI-TERRANEAN RIVER AS INFLUENCED BY LAND USES IN THE WATERSHED.

Barcelona Univ. (Spain). Dept. de Ecologia. F. Sabater, S. Sabater, and J. Armengol. Water Research WATRAG, Vol. 24, No. 2, p 143-155, February 1990. 5 fig, 3 tab, 24 ref

Descriptors: *Geochemistry, *Land use, *River systems, *Ter River, *Water chemistry, Alkalinity, Calcium, Chemical properties, Chlorides, Hydrogeology, Lithology, Magnesium, Potassium, Salinity, Sodium, Sulfates, Watersheds.

The influence of watershed characteristics on the The influence of watershed characteristics on the morganic chemical composition in the water of a Mediterranean river (the Ter), was studied. The main physiographical features (topographic characteristics, lithology and soils, climate and vegetation, land use, human activities) were defined in every subbasin. All the physiographical information for the whole river catchment was computerized by means of digitalized areas of 0.25 sq km. ized by means of digitalized areas of 0.25 sq km. Several principal components analysis were car-ried out in order to characterize the basin physiog-raphy. Moreover, this same tool was used to estab-lish the relationships between watershed character-istics and physico-chemical composition of the Ter river wastes. The ordination of physiographical features may be interpreted as revealing the struc-ture of the river. The changes produced in the conservative parameters (alkalinity, sulfates, calci-um, sodium, magnesium, potassium, chloride) are um, sodium, magnesium, potassium, chloride) are related to the chemical inertia of the water, defined as the increasing resistance of the water chemistry downstream to sudden changes. Therefore, an identical disturbance will not have the same effect when produced in upstream or downstream stretches. Finally, there is a very high correlation between several land use variables (climate, vegetation and human activities) and nutrient content. However, the lithology is not correlated with the river Ter water salinity. (Author's abstract) W90-07415

DRUM CENTRIFUGATION MODELLING OF LONG TERM POLLUTANT MIGRATION THROUGH A SOIL LAYER. Cambridge Univ. (England). Dept. of Engineering. R. I. Edwards.

Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-167365. Price codes: E05 in paper copy, A01 in microfiche. Report No. CUED/D-SOILS/TR220, 1988. 43p, 17 fig, 3 ref.

Descriptors: *Centrifugation, *Groundwater pollu-tion, *Model studies, *Path of pollutants, *Soil contamination, Computer programs, Leaching, Waste disposal.

With the advent of the awareness of potential problems associated with land based waste repository configurations, studies have been conducted to examine some of the site processes involved. These include the processes by which leaching pollutants migrate away from these sites, with the subsequent contamination of the groundwater system. Three drum centrifuge models were constructed, and tested, supplemented with laboratory experiments at 1 g which determined parameters required in the numerical analysis of transport processes. These included sorption, diffusion and dispersion coefficients for the pollutants and dispersion coefficients for the pollutants and porous medium employed in the model. The model simulated a large flooded landfill site, overlying a relatively impermeable clay layer. Within this

layer a differential hydraulic gradient induced an overall advective flow down towards an underlying aquifer in which a horizontal flow existed. A relatively coarse grade of kaolin was used as the porous medium because of its relatively low cation exchange capacity. A 0.5m NaCl solution was used to represent the landfill leachate. The centrifuge to represent the landfill leachate. The centrifuge was run continuously at 400g for 56 hour, producing data representing 1023 years prototype time. Core samples of the clay where then taken for analyses. Based on calculated Peclet number for chloride dispersion of less than 0.04 for duration of the centrifuge run and the chloride dispersion coefficient of 0.0000029 from previously laboratory diffusion data, the observed test parameters were used to forecast arrival times of the maximum concentration level with denth using POLLUTE. concentration level with depth using POLLUTE concentration level with depth using POLLUTE, a one-dimensional computer program designed to simulate pollutant migration through a non-homogenous soil deposit. The discrepancy between the results generated from POLLUTE and the test results observed indicated that the test conditions results observed indicated that the test conditions experienced were possibly not of a one-dimensional nature. The chloride concentration data in the contaminated underdrain war run with POLLUTE to provide an indication of the upward chloride diffusion from the drain. However, the upward currision from the drain. However, the upward migration of chloride by molecular diffusion in the test duration had a negligible effect on migration of chloride from the clay surface. (Lantz-PTT) W90-07465

KINETICS AND MECHANISMS OF THE RE-LEASE OF TRACE INORGANIC CONTAMI-NANTS TO GROUND WATER FROM COAL ASH BASINS ON THE SAVANNAH RIVER

PLANT.
Claffin Coll., Orangeburg, SC.
Available from the National Technical Information
Service, Springfield, VA. 22161, as DE89-006368.
Price codes: A03 in paper copy, A01 in microfiche.
Report No. DOE/SR/15170-2, August 31, 1988.
Progress Report for the period October 1, 1987
through September 30, 1988. 39p, 3 fig. 19 tab, 18
ref. DOE Contract DE-FG09-86SR-15170.

Descriptors: *Coal wastes, *Groundwater pollu-tion, *Path of pollutants, *Savannah River Plant, Arsenic, Ash, Cadmium, Chemical interactions, Chromium, Hydrogen ion concentration, Iron, Kinetics, Manganese, Nickel, Pore water, Trace

Undisturbed cores of ashes from the sites, randomly selected in the Old and New ash disposal basins, located in D-area on the Savannah River Plant (SRP) were removed and sequentially extracted for the quantitative estimation of dissolved (pore water), exchangeable, Fe/Mn oxide associated and organic matter associated trace inorganic contaminants (i.e., As, Cd, Cr and Ni). Undisturbed cores of ashes were leached with desionized water, nitrice of ashes were leached with desionized water, nitrice of ashes were leached with deionized water, nitric acid (pH3) and calcium hydroxide (pH8) solution to evaluate the kinetics of release of trace metals. to evaluate the kinetics of release of trace metais. Sluiced water samples, at four locations in the new ash basins, and groundwater samples from wells, installed at the ash sampling sites were tested for Ca, Mg, Na, K, P, AI, Fe, Mn, Ti, Cu, Zn, Ni, Mo, Cd, Si, Cr, Sr, B, Ba, Pb, V, As and Se. A very small fraction of the total elemental concentration, except Cd, were found in the dissolved phase. Most of the easily releasable elements in the ashes were found associated with Fe/Mn oxides and organic matter. Analysis of the data clearly indi-cates the release and mobilization of trace contaminants to the lower horizons of the impounded ashes. Elemental translocation was found to be ashes. Elemental translocation was found to be more serious in the old ash basin. Several mechanisms appeared operating in these systems, leading to the release and transport of trace inorganic contaminants. The decomposing organic matter, especially in the old ash basin, was considered responsible for lowering the pH of surface horizons. The activity appeared especially intense in the subsurface horizons (7.5-15 cm). Low pH is responsible for solubilizing the trace elements which are complexed by active organic compounds. The leached components remain in solution until the percolating water reaches a zone of pounds. The leached components remain in solu-tion until the percolating water reaches a zone of higher pH. In this zone, the acidity is neutralized and subsequent redox reactions lead to coagulation and precipitation of the dissolved element. Trace

elemental groundwater contamination may result when the deeper layers of the ash column become acidified. Deionized water, nitric acids (pH3) and calcium hydroxide (pH8) failed to release signifi-cant amounts of trace metals from the ash columns. Leachates pH; even for the second leaching with nitric acids, were found neutral to slightly alkaline which in general are not conducive for the mobili-zation of metals. (Lantz-PTT) W90-07467

MERCURY: OCCURRENCE AND TURNOVER OF MERCURY IN THE ENVIRONMENT.

National Swedish Environment Protection Board. Solna. Research Dept.
O. Lindqvist, K. Johansson, and B. Timm.

O. Lindqvist, K. Johansson, and B. Timm. Available from the National Technical Information Service, Springfield, VA. 22161, as DE88-754438. Price codes: A03 in paper copy, A01 in microfiche. Report No. SNV--3265, November 1986. 43p, 7 fig, 7 tab, 4 append.

Descriptors: *Mercury, *Path of pollutants, *Sweden, Bioaccumulation, Fish, Forest watersheds, Lakes, Research priorities.

This is a progress report on a coordinated research In it is a progress report on a coordinated research project on the occurrence and turnover of mercury in the Swedish environment. The purpose is to describe and quantify those mercury fluxes in the air, ground and water that are most significant to the enrichment of mercury in the food chains. The the enrichment of mercury in the food chains. The project focuses on the question of why the mercury content is high compared with background levels even for fish from waters not directly affected by local emissions. The project attempts to: explain why the mercury content in fish in Swedish forest lakes is high now compared with estimated levels in the 19th century, and propose countermeasures that can be taken to reduce the mercury content in fish. (Lantz-PTT)

STEEL CREEK WATER QUALITY: L LAKE/ STEEL CREEK BIOLOGICAL MONITORING PROGRAM, NOVEMBER 1985-DECEMBER

Environmental and Chemical Sciences, Inc.,

Aiken, SC.

M. J. Chimney, and J. H. Nagle.

Available from the National Technical Information
Service, Springfield, VA. 22161, as DE89-007935.
Price codes: A06 in paper copy, A01 in microfiche.
Report No. DPST-88-658, March 1988. 195p, 38
fig, 3 tab, 23 ref, append. Savannah River Laboratory Contract AX-720581.

Descriptors: *Dam effects, *Environmental effects, *L-Lake, *Limnology, *Savannah River, *South Carolina, *Steel Creek, *Water resources development, Dissolved oxygen, Heavy metals, Hydrogen ion concentration, Monitoring, Nitrogen, Nutrents, Phosphorus, Potassium, Sodium, Sulfates,

The objective of this portion of the L-Lake/Steel Creek Biological Monitoring Program is to document the current status of water quality in the Steel Creek system, assess the overall impact of L-Reactor operation and L-Lake on Steel Creek water quality, determine whether ecologically important alterations in the water quality of Steel Creek have occurred and compare Steel Creek water quality, determine which could be portant alterations in the water quality of Steel Creek have occurred, and compare Steel Creek water quality with other southeastern lotic systems. This report covers the period November 1985 through December 1987. The impoundment and discharge from L-Lake has had an impact on the water quality of Steel Creek through the introduction of Savannah River water into Steel Creek. Downstream gradients were sometimes observed at creek corridor Stations 275 to 290 (either for at creek corridor Stations 275 to 290 (either for yearly means or individual values) in temperature, dissolved oxygen, pH, total inorganic carbon, ortho-, and total phosphorus, nitrate-nitrogen, and ammonia-nitrogen, total inorganic nitrogen, total and dissolved sodium, chloride, total and dissolved manganese, total and dissolved potassium, total and total and dissolved calcium. These differences can be attributed to the effects of cooling, outgass-

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ing, and metabolic activity of stream organisms. The occurrence of gradients was not consistent among variables. Open vs. closed canopy swamp/ among variables. Open vs. croscu canop, delta station differences were sometimes observed for temperature, ortho, and total phosphorus, nicolation introgen, total and for temperature, ortho-, and total phosphorus, ni-trate-nitrogen, total inorganic nitrogen, total and dissolved sodium, and sulfate. Inspection of pre-, and post-impoundment data from the entire study indicated that substantive increases in temperature, conductivity, alkalinity, total phosphorus, nitrate-nitrogen, ammonia-nitrogen, total sodium, dis-solved sodium, and chloride, and decreases in pH have occurred over pre-impoundment levels. These changes were not thought to be limiting to the establishment and/or maintenance of a bal-anced biological community. Steel Creek water quality during this study was similar to the range anceo lological community. Steel creek water quality during this study was similar to the range of values observed in other representative lotic systems and judged to be typical of southeastern surface systems. (Lantz-PIT)

SUPERFUND RECORD OF DECISION: HEN-DERSON ROAD, PA.

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field SG. W90.07471

RECORD OF DECISION: SUPERFUND GURLEY PIT, AR.

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field 5G. W90-07474

COMPARATIVE STUDY OF PRECIPITATION CHEMISTRY AT INLAND, COASTAL AND ISLAND SITES IN THE BOTHNIAN BAY

Stockholm Univ. (Sweden). Meteorologiska Insti-L. Granat

Available from the National Technical Information Service, Springfield, VA. 22161, as N89-12135. Price codes: A03 in paper copy, A01 in microfice, Report No. CM-73, May 1988. 23p, 5 fig, 4 tab, 2

Descriptors: *Baltic Sea, *Chemistry of precipita-tion, *Coasts, *Gulf of Bothnia, *Path of pollut-ants, *Water pollution sources, Calcium, Compari-son studies, Hydrogen ion concentration, Nitrites,

Rain chemistry measurements were made in the northern part of the Baltic Sea, in the Gulf of Bothnia (Kvarken), on both a small island and on a light-house, and compared with data from nine coastal and inland sites on both sides of the water. The distance from coast to coast in the area is 120 km. The concentration of SO4, NO3 and H(+) at the island site was about equal and NH4 about 10% less than the value obtained by linear interpolation between coastal sites. The amount of precipitation was about 30% less on the island-possibly representing conditions over the open water. The deposition was estimated to be 30 to 40% lower than the values measured at coastal sites. The concentration of seasalt components was higher at the island site, but the level may depend on the sampling site. The concentration of Ca and K was a few microequivalents/L higher at the island site. This study together with information from the national Swedish air and precipitation chemistry network suggests that estimates of wet deposition of several components of anthropogenic The concentration of SO4, NO3 and H(+) at deposition of several components of anthropogenic origin to a large water body, should be made from a combination of concentration data obtained from many measurements around the water body with particular reference to coastal sites and estin amount of precipitation over the water. A direct estimate based on deposition at coastal sites will estimate based on deposition at coasta sites win give too high values. The measurements at the light house were probably affected by the very exposed location and the results were considered to be less reliable than those from the much less exposed site on the island. (Author's abstract) W90-07478

MOBILITY OF COLLOIDAL PARTICLES IN THE SUBSURFACE: CHEMISTRY AND HYDROLOGY OF COLLOID-AQUIFER INTER-ACTIONS

Oak Ridge National Lab., TN. Environmental Sciences Div

ences Div.

J. F. McCarthy, and F. J. Wobber.

Available from the National Technical Information
Service, Springfield, VA. 22161, as DE90000724.

Price codes: A06 in paper copy, A01 in microfiche.

A meeting Held on October 4-6, 1989, Manteo,
North Carolina. Report No. DOE/ER-0425, October 1988. 11p, 2 app

Descriptors: *Aquifers, *Colloids, *Conferences, *Geochemistry, *Geohydrology, *Groundwater movement, *Mass transport, *Path of pollutants, Decontamination, Inorganic compounds, Organic compounds, Research priorities, Sampling, Solute

A meeting, titled the same as this report, was held on October 4-6, 1989, in Manteo, North Carolina. The purpose of the meeting was to examine the chemical and hydrologic factors controlling the chemical and hydrologic factors controlling the transport and deposition of organic and inorganic colloidal particles in subsurface environments. Sessions dealt with technical difficulties in sampling and characterizing colloidal particles in groundwater, and with observations of colloid movement in laboratory and field systems, with an emphasis on the chemical and hydrological factors controlling transport. Discussion sessions summarize the concensus of the group on two important issues: (1) identifying natural conditions that promote either the transport or the deposition of colloids, with the intent of focusing attention on those subsurface environments with the greatest probability for the occurrence of mobile colloids, and (2) exploring strategies to manipulate colloid mobilization and deposition within subsurface systems to aid in remediation or mitigation of contamination at hazardous waste sites. Based on the presentations and discussions, participants attempted to at hazardous waste sites. Based on the presenta-tions and discussions, participants attempted to reach a concensus on the priorities for research on groundwater colloids. Highest priority was given to colloid sampling methods, understanding of the hydrogeochemistry of colloid formation and deponydrogeochemistry of colloid formation and depo-sition, and application of this understanding to waste management. Important and critical labora-tory studies must be tied to experimental questions driven by field studies, including comparative stud-ies at a network of field sites that bound the range of conditions where collected may occur. This docof conditions where colloids may occur. This doc-ument summarizing the meeting includes: abstracts or technical presentations, summaries of discussion topics, and a description of research priorities. of technical presen W90-07482

SUBSURFACE SCIENCE PROGRAM. PROGRAM OVERVIEW AND SCOPE: OVERVIEW OF THE SCIENTIFIC SCOPE, GOALS AND RELEVANCE OF FUNDAMENTAL RESEARCH IN SUBSOILS, GROUNDWATER AND CHEMICAL CONTAMINATION SPONSORED BY THE U.S. DEPARTMENT OF

epartment of Energy, Washington, DC. Office of

Energy Research. Report No. DOE/ER-0444, February 1990. 34p, 31 ref.

Descriptors: *Groundwater, *Groundwater move-ment, *Groundwater pollution, *Path of pollut-ants, *Research priorities, *Soil contamination, *Subsoil, Biodegradation, Cleanup operations, Geochemistry, Geohydrology, Hydraulic proper-ties, Microbiological studies, Model studies, Site remediation, Soil water, Solute transport.

Long-term basic research of the Subsurface Science Program focuses on: (1) the fundamental physical, chemical, and biological mechanisms that control the reactivity, mobilization, stability, and transport of chemical mixtures in subsoils and transport of chemical instruces in subsolus and groundwater; (2) geohydrology, including hydrau-lic and geochemical properties that affect transport and numerical (predictive) modeling of coupled hydraulic-geochemical-microbial processes; and (3) the microbiology of deep sediments and ground-water. Emphasis is given to inter-disciplinary and

multi-disciplinary, rather than single-discipline or narrowly-focused research. The general goals of the program are to: develop a mechanistic under-standing of subsurface (subsoil/groundwater) proc-esses and properties, including contaminant inter-actions; identify innovative in situ remediation con-crets, with emphasis on environmental manipulacepts, with emphasis on environmental manipula cepts, with emphasis on environmental manipula-tion; improve predictions of contaminant mobiliza-tion, stabilization, and transport, with emphasis on complex mixtures; develop new and more effective in situ physical, chemical, and microbiological sampling, characterization, and monitoring meth-ods, with emphasis on field methods; evaluate the long-term effects of contaminants and remedial long-term effects of contaminants and remedial action on natural subsurface systems, with empha-sis on microbial ecosystems; and, facilitate technol-ogy and scientific information transfer to Dos sites. The program is organized into interdisciplisites. The program is organized into interdisciplinary subprograms with research conducted by national lab-university consortia, which are guided by five-year research plans: co-contaminant chemistry subprogram; geochemical transport processes/colloids subprogram; multicomponent predictive models/expert systems subprogram; multiphase fluid flow subprogram; deep microbiology subprogram; biodegradation/microbial physiology subprogram; coupled processes subprogram; field scale subprogram; and environmental science research center. (Lantz-PTT) W90-07485

USE OF ELECTROMAGNETIC METHODS IN GROUND-WATER CONTAMINATION STUD-IES: AN APPLICATION AT THE SANITARY LANDFILL, FARMINGTON, CONNECTICUT. Geological Survey, Hartford, CT. Water Resources Div.

For primary bibliographic entry see Field 7B. W90-07488

ACID RAIN IN THE UNITED KINGDOM: SPA-TIAL DISTRIBUTIONS AND SEASONAL VARIATIONS IN 1986.

Warren Spring Lab., Stevenage (England).
G. W. Campbell, J. L. Cocksedge, S. M. Coster,
A. L. Dennis, and M. Devenish.

A. L. Dennis, and M. Devenish.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-197966.
Price codes: E06 in paper copy, E06 in microfiche.
Report No. LR-691(AP)M, 1988. 72p, 38 fig, 7 tab,
47 ref, append.

Descriptors: *Acid rain, *England, *Northern Ire-land, *Path of pollutants, *Scotland, *Seasonal variation, *Spatial distribution, *Wales, Ammonia, Chlorides, Mapping, Nitrates, Rain, Sulfates.

Maps of the concentration and deposition of acidity and other ions over all of the United Kingdom during 1986 are compared with the limited data available for earlier periods. Seasonal variations are presented and box plots used to summarize information on frequency distributions. Nonmarine sulfate and nitrate have broadly similar reaction presents. marine sulfate and nitrate have broadly similar spatial patterns. The smallest concentrations are found in the north and west with those in the East Midlands and East Anglia greater by up to a factor of 10. Although the source distribution of ammonia is different from those of sulfur dioxide or oxides of nitrogen, the pattern of ammonium concentra-tion in precipitation is broadly similar to those of non-marine sulfate and nitrate. Over most of the country non-marine chloride comprises < 10% of total chloride. Sulfate, in contrast, is mainly man-made the marine component being < 20% over most of England and only exceeding 50% in coast-al areas. In most areas 1986 was wetter than aver-age, typically by about 20%. Combining the con-centration fields with the 1986 rainfall field has allowed deposition of the major ions to be estimat-ed. In general deposition is greatest in mountainous areas of Scotland, northern England and Wales. Comparatively large deposition can also occur in lower rainfall areas which experience high concentrations including the East Midlands, East Anglia and central southern England. In the case of nonmarine sulfate and acidity, comparison with the limited data for the period 1978-1985 shows a contraction of the areas receiving > 1.0 g S/sq m and > 0.05 g H(+)/sq m, despite the fact that in

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many such areas 1986 rainfall was higher than average. For nitrate this is less evident. The four major non-marine ions all exhibited seasonal variation during 1986. (Lantz-PTT) W90-07489

TRENDS IN OIL DISCHARGED WITH AQUE-OUS EFFLUENTS FROM OIL REFINERIES IN

OUS EFFLUENTS FROM OIL REFINERIES IN WESTERN EUROPE, 1987 SURVEY. CONCAWE, The Hague (Netherlands). Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-206064. Price codes: E03 in paper copy E03 in microfiche. CONCAWE Report No. 3/89, December 1988. 11p, 1 fig, 6 tab, 7 ref.

Descriptors: *Europe, *Industrial wastes, *Oil pol-lution, *Oil refineries, *Surveys, *Water pollution control, *Water pollution sources, *Water quality trends, Biological wastewater treatment, Oil indus-try, Wastewater disposal, Wastewater treatment.

This report summarizes information on Western European oil refineries' effluent water quantity, oil content and treatment processes for 1987. Refineries responding to the CONCAWE (the oil comparies responding to the CONCAWE) nies' European Organization for Environmental and Health Protection) questionnaire represent nies' European Organization for Environmentai and Health Protection) questionnaire represent 82% of the oil refining capacity in Western Europe. The data have been compared with those obtained in previous CONCAWE surveys. It is shown that: further limited refinery capacity closures have occurred since 1984 but overall the number of refineries reporting has increased. This is the result of new CONCAWE membership and the participation of refineries which had not previously supplied data; about 75% of the refineries surveyed are equipped for biological treatment of their aqueous effluents, the total amount of aqueous effluents discharged has fallen, even though the number of refineries reporting has increased; there has been a slight reduction in the ratio of oil discharged to oil processes. This fell from 12 tons/million tons of soil processed in 1984 to 10.3 tons/million tons in 1987; 4640 tons of oil were discharged with the aqueous effluents from 89 refineries in 1984; there has been a 90% reduction in oil in effluent from refineries since the 44,000. in oil in effluent from refineries since the 44,000 tons reported in the initial survey conducted in 1969. (Author's abstract)

SURVEY AND CLASSIFICATION OF DELA-

WARE'S PUBLIC LAKES.
Delaware State Dept. of Natural Resources and
Environmental Control, Dover.
For primary bibliographic entry see Field 2H.
W90-07495

SUMMARY OF SELECTED DATA ON CHEMI-CAL CONTAMINANTS IN SEDIMENTS COL-LECTED DURING 1984, 1985, 1986, AND 1987. National Oceanic and Atmospheric Administration, Rockville, MD.

Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-206809. Price codes: A06 in paper copy, A01 in microfiche. NOAA Technical Memorandum NOS OMA44, November 1988. 88p, 3 tab, 12 ref, 4 append.

Descriptors: *Data collections, *Organic compounds, *Path of pollutants, *Sediment contamination, Boston, Chlorinated hydrocarbons, Los Angeles, New York, Pesticides, Polychlorinated biphenyls, Polycyclic aromatic hydrocarbons, San Diego, Seattle, Trace elements.

Since 1984, the National Oceanic and Atmospheric Administration's (NOAA) National Status and Trends (NS and T) Program has analyzed samples of surface sediment collected at about 200 coastal and estuarine sites throughout the United States. and estuarine sites throughout the United States. The chemical contaminants measured are chlorinated pesticides, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and 12 trace elements. Sediment characteristics such as grain size, which affect contaminant concentrations, have also been quantified. With few exceptions, the higher levels of contamination have been found

among the 175 sites where the sediment is muddy rather than sandy. Most of the highest concentrations for any particular contaminant have been at the 20 sites near Boston, New York, San Diego, Los Angeles, or Seattle. Despite being sandy, sediments at two Long Island Sound sites showed high levels of PAHs. Except for some sites near the Florida cities of Jacksonville, Tampa, Panama City, and Ft. Walton Beach, levels of contamination at sites in the Gulf of Mexico and in the southeastern United States were relatively low. (Author's abstract)

KINEMATIC MODELING OF MULTIPHASE SOLUTE TRANSPORT IN THE VADOSE

ZONE.
Texas Univ. at Austin. Dept. of Civil Engineering.
R. J. Charbeneau, J. W. Weaver, and V. J. Smith.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-207948.
Price codes: A06 in paper copy, A01 in microfiche.
Report No. EPA/600/2-89/035, June 1989. 158p,
40 fig. 7 tab, 62 ref, 2 append. EPA Contract CR813080.

Descriptors: *Groundwater pollution, *Kinematic flow theory, *Model studies, *Path of pollutants, *Soil water, *Soliute transport, *Vadose zone, Groundwater movement, Hazardous wastes, Infiltration, Leachates, Mathematical models, Organic compounds, Simulation analysis.

The development of a computationally efficient simulation model for multiphase flow of organic hazardous waste constituents in the shallow soil environment was investigated. Such a model is appropriate for investigation of fate and transport of organic chemicals introduced to the soil through of organic enemicals introduced to the soil through spills on the ground surface, leakage from surface impoundments or underground storage tanks, or land treatment of hazardous wastes. During the initial phases of a site investigation there usually initial phases of a site investigation there usually does not exist sufficient data to support the application of comprehensive, computationally expensive numerical models. Simplified physically based models which can address the transport of an organic constituent experiencing volatilization, multiphase partitioning, biodegradation, and migration may be preferred. Two models based on the kinematic theory of multiphase flow were developed. The Kinematic Oily Pollutant Transport (KOPT) model assumes steady inflitration of water based on the expected annual inflitration are the Kinematic Rainfall and Oily Pollutant Transport (KOPT) model includes transient hydrologic phenomens (evaporation and infiltration) along tancer1) model includes transient hydrologic phenomena (evaporation and infiltration) along with a model for stochastic generation of rainfall. The examples presented (oil spill in a fine sand and in a coarse sand, gasoline leak, and land treatment) suggest that the KOPT model may be preferred for most applications. (Author's abstract) W90-07503

COEUR D'ALENE BASIN - EPA WATER QUALITY MONITORING, 1972-1986. Environmental Protection Agency, Seattle, WA. Region X.

For primary bibliographic entry see Field 5G. W90-07504

5C. Effects Of Pollution

ECOLOGICAL EFFECTS OF COOLING WATER DISCHARGE ON HYDROLITTORAL EPILITHIC DIATOM COMMUNITIES IN THE NORTHERN BALTIC SEA.
Uppsala Univ. (Sweden). Inst. of Ecological

Botany. P. J. M. Snoeijs.

Diatom Research, Vol. 4, No. 2, p 373-398, 1989. 16 fig, 2 tab, 71 ref, append.

Descriptors: *Baltic Sea, *Cooling water, *Diatoms, *Ecological effects, *Environmental effects, *Periphyton, *Sweden, *Temperature effects, *Thermal pollution, *Water pollution effects, Algal blooms, Biomass, Brackish water, Cyanophyta, Littoral environment, Mathematical studies,

Melosira, Nitzschia, Nuclear powerplants, Plant morphology, Seasonal variation, Species composi-tion, Water temperature.

The discharge of brackish cooling water from a nuclear power plant on the Swedish Baltic coast has major effects on the species composition, biomass and seasonal variation of epilithic diatom communities in the hydrolittoral zone. Greatest effects occur in winter and early spring, when enormous diatom blooms are caused by the higher water temperatures and by the absence of an ice cover, which implies high light availability early in the season. A low light regime in mid-winter inhibits growth for a short period only. Canonical correspondence analysis which was used to display the relationship of community composition to sampling site and date reproduced the seasonal cycle, pling site and date reproduced the seasonal cycle, and placed each site in its correct relative position and placed each site in its correct relative position in terms of annual-mean temperature anomaly and flow rate. Individual species were placed according to their ecological optima with respect to the seasonal cycles of light, temperature and water level, and the site-dependent anomalies in temperature and flow rate. Seasonal variation exceeded variation between sites, and within-site variation was smaller than variation between sites. Seasonal variation can be attributed to the seasonal cycles of light, temperature and water level; variation be-tween sites to temperature and flow rate anomalies, tween sites to temperature and flow rate anomalies, and the presence or absence of winter ice. Parallel studies of macroalgae, including macroscopic colonies of blue-greens and diatoms, and macrofauna show weaker seasonal cycles, but all groups show some seasonal pattern and the patterns of variation between sites are similar for all three groups. The cooling water discharge has no effect on diversity. The seasonal and spatial occurrences of the species can be related to growth forms and life-form strategies. Melosira spp. and Nitzschia filiformis are egies. Melosira spp. and Nitzschia filiformis are especially favored by the cooling water discharge especially layored by the cooling water discharge in winter. They respond opportunistically by growing fast in large upright colonies and do not need macroalgae as substrata to reach into the water column. Different morphologies and life histories affect the competitive balance among eurythermic species in different environments. (Author's abstract) W90-06579

ECOLOGICAL STUDIES ON THE PLANK-TONIC PROTOZO OF A EUTROPHIC RESER-VOIR (RIO GRANDE RESERVOIR-BRAZIL). Universidade Federal de Sao Carlos (Brazil). Dept. de Ciencias Biologicas.

For primary bibliographic entry see Field 2H. W90-06580

CILIATED PROTOZOAN COMMUNITIES IN A FLUVIAL ECOSYSTEM.

Barcelona Univ. (Spain). Facultat de Biologia. For primary bibliographic entry see Field 2H.

MACROINVERTEBRATE COMMUNITIES IN WHEELER RESERVOIR (ALABAMA) TRIBU-TARIES AFTER PROLONGED EXPOSURE TO

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.

Aquacumus. E. C. Webber, D. R. Bayne, and W. C. Seesock. Hydrobiologia HYDRB8, Vol. 183, No. 2, p 141-155, Octover 9, 1989. 6 fig, 12 tab, 26 ref.

Descriptors: *Alabama, *Benthic fauna, *Bottom sampling, *DDE, *DDT, *Macroinvertebrates, *Streams, *Water pollution effects, Caddisflies, Ephemoptera, Halogenated pesticides, Midges, Nematodes, Oligochaetes, Plecopter, Population

Quarterly measurements were conducted of the structure, abundance, and diversity of macroinver-tebrates comprising two distinct, but overlapping zoobenhic communities in backwaters to Wheeler Reservoir, Alabama. The study area included por-tions of Huntsville Spring Branch and Indian Creek which contain massive quantities of DDT residues (DDT residues = DDT, DDD, DDE).

Effects Of Pollution—Group 5C

Additionally effluents entering Huntsville Spring Branch just upstream from the study area have resulted in nutrient enrichment. Herpobenthos (burrowed in bottom sediments) and haptobenthos (attached to substrates) were collected at seven (attached to substrates) were collected at seven stations along an east-west gradient. Fifty taxa were collected from dredge samples of the herpobenthos; tubificid oligochaetes and chironomid larvae comprised 97% of the herpobenthos. At the control site and the site with the highest sediment DDT residues, oligochaete density averaged twice that of chironomids. Downstream, densities of both groups were similar. Herpobenthos was dominated by detrital-algal feeders in Huntsville Spring Branch, while in Indian Creek, predaceous chironomids were more numerous. Taxa diversity was a constant of the property of the propert omids were more numerous. I axa diversity was lowest at the two upper sites. Forty-five taxa were collected from artificial substrate samples of the haptobenthos. Naidid oligochaetes and chirono-mids dominated the haptobenthos, although nema-todes were occasionally abundant. Chironomids were more abundant than oligochaetes at all sites, were more abundant than oligochaetes at all sites, except the control station, which received the greatest nutrient enrichment from sewage effluents. Nutrient enrichment from sewage effluents. Nutrient enrichment from sewage effluents apparently had greater impact on zoobenthic communities in the Huntsville Spring Branch-Indian Creek system than did DDT contamination. However, the presence of DDT undoubtedly contributed, in part, to the few Ephemeroptera, Plecoptera, and Trichoptera collected at contaminated stations. Based on the density of oligochaetes and chironomid larvae at the highest DDT residue station, macroinvertebrates in this system are resistant to DDT residues. (Mertz-PTT) W90-06588

ACCUMULATION OF A PEPTIDE TOXIN FROM THE CYANOBACTERIUM OSCILLA-TORIA AGARDHII IN THE FRESHWATER MUSSEL ANADONTA CYGNEA.

Abo Akademi, Turku (Finland). Dept. of Biology. J. E. Eriksson, J. A. O. Meriluoto, and T. Lindholm.

Hydrobiologia HYDRB8, Vol. 183, No. 3, p 211-216, October 15, 1989. 4 fig, 31 ref.

Descriptors: *Algal toxins, *Cyanophyta, *Eutro-phic lakes, *Mussels, *Toxins, Microcystis, Oscilla-

The cyanobacterium (Blue-green alga) Oscillatoria agardhii is common in eutrophic lakes and reser-The cyanobacterium (Blue-green alga) Oscillatoria agardhii is common in eutrophic lakes and reservoirs and like many other cyanobacteria, it has been frequently associated with various kinds of water management problems. There are several reported on toxic strains of this species. The toxic principle of this cyanobacterium has been characterized as extremely poisonous to the liver with properties closely resembling those of peptide toxins isolated from the cyanobacterium Microcystis aeruginosa. Swan mussels (Anodonta cygnes) were exposed to a toxic strain of the cyanobacterium Oscillatoria agardhii. Mussels accumulated large amounts of the peptide Oscillatoria toxin which was present in low concentrations within the cyanobacterial cells in the test aquaria (40-60 microgram Oscillatoria toxin/L). The toxin concentration in the mussels increased during the experiment and after 15 days of exposure the concentration was 70 +/-2 microgram/g freeze dried tissue. The highest concentration of the toxin (130 microgram/g of freeze dried tissue) was found in the hepatopanocreatic tissue. The toxin did not seem to be metabolized in the mussels and they were not killed by the high toxin concentrations within them. After two months in clean water detectable amounts of toxin were still present in the mussels. amounts of toxin were still present in the mussels.
(Mertz-PTT)

EFFECT OF PHENOLIC ACIDS ON GROWTH OF CHLORELLA PYRENOIDOSA. Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.

OF ENVIORMENT AND A COLOR OF THE COLOR OF TH

Descriptors: *Algal control, *Chlorophyta, *Macrophytes, *Phenols, *Water pollution effects, Al-

gicides, Chlorella, Degradation, Hydroxybenzoic acid, Syringic acid, Vanillic acid.

Three phenolic acids, vanillic syringic and 4-hydroxybenzoic acid, accumulated in laboratory cultures of a macrophyte, Ceratophyllum demersum L. Qualitative bioassay with the green alga Chlorella pyrenoidosa demonstrated an algicidic potential for these compounds. It was suggested that these compounds were responsible for reported observations of algal inhibition in macrophyte culture. Accumulation in water of these phenolics can possibly be explained by the latent degradation of lignified tissues of the macrophytes as they are major lignin degradation products. Static bioassays were conducted on Chlorella pyrenoidosa using vanillic acid, syringic acid, and 4-hydroxybenzoic acid, strongic acid, and supplementations the control. For both compounds, concentrations zoic acid stimulated cultural growth compared to the control. For both compounds, concentrations of 0.3 millimoles and 0.4 millimoles were initially inhibitory, then after 3-5 days became stimulatory compared to control. Bioassays with syringic acid resulted in 100% mortality in C. pyrenoidosa. Bacteria-free cultures of C pyrenoidosa were stimulated by vanillic acid at 0.1 millimoles and inhibited at 0.4 millimoles with no shift in resonne observation. 0.4 millimoles with no shift in response observed. It was suggested that degradation of test material is responsible for the shift from inhibition to stimularesponsible for the shift from inhibition to stimula-tion. All three compounds are reported to change from enzyme synergists to antagonists as concen-trations are reduced. Because these compounds are major components of humic material, it is suggested that they have the potential to confound studies involving interaction of toxins and humics. (Mertz-PTT) W90-06595

TOXICITY TEST WITH FISHES (TESTE DE TOXICIDADE COM PEIXES MANTIDOS EM

GAIOLA FLUTUANTE).
Universidade Federal de Alagoas, Maccio (Brazil).
For primary bibliographic entry see Field 5B.
W90-06602

OXYGEN DEFICIT IN LAKE DOM HELVECIO OXYGEN DEFICIT IN LAKE DOM HELVECIO (PARQUE FLORESTAL DO RIO DOCC, MINAS GERAIS), (O DEFICIT DE OXIGENIO NO LAGO DOM HELVECIO (PARQUE FLORESTAL DO RIO DOCE, MINAS GERAIS), Universidade Estadual Paulista, Botucatu (Brazil). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-06603

PRIMARY PRODUCTION OF PHYTOPLANK-PRIMARY PRODUCTION OF PHYTOPLANK-TON OF CHASCOMUS POND. (PROV. BS.AS., ARGENTINA). CRITICAL EVALUATION OF PHOTOSYNTHESIS VALUES OBTAINED BY OZ AND 14C METHODS, (PRODUCCION PRI-MARIA DEL FITOPLANCTON DE LA LA-GUANA DE CHASCOMUS (PROV. DE BUENOS AIRES, ARGENTINA). EVALUACION CRITICA DE LOS VALORES DE FOTOSINTE-SIS OBTENIDOS POR LOS METODOS DEL

Universidad Nacional de La Plata (Argentina). Inst. de Limnologia. For primary bibliographic entry see Field 2H. W90-06604

ACTION OF TEMPERATURE AND WATER HARDNESS ON THE TOXICITY OF HEXAVA-LENT CHROMIUM IN GAMMARUS ITALI CUS GOEDM. (CRUSTACEA, AMPHIPODA). CUS GOEDM. (ERUSI ACEA, AMPHIPUDA). Aquila Univ. (Italy). Dipt. di Scienze Ambientali. C. Pantani, P. F. Ghetti, and A. Cavacini. Environmental Technology Letters ETLEDB, Vol. 10, No. 7, p 661-668, July 1989. 4 fig.l tab, 19

Descriptors: *Chromium, *Gammarus, *Toxicity, *Water pollution effects, *Water temperature, Amphipods, Ecological effects, Ecotoxicology, Hard-

Toxicity in aquatic environments can be increased or masked by changing natural physical and chemical factors. Since a process of water pollution can

rarely be attributed to a single cause, these potenrarely be attributed to a single cause, these poten-tially synergistic factors must be taken into account when forecasts are made of the environmental risk created by potential pollutants. The action of tem-perature (8 and 18 °C) and water hardness (35, 70, 140, 280, and 560 mg/liter of calcium carbonate) on the toxicity of hexavalent chromium on popula-tions of Gammarus italicus Goedm. (male, female, and juveniles) was studied using both renewal and continuous flow conditions. Low hardness associcontinuous flow conditions. Low hardness associated with high temperatures produced the highest mortality rates in the amphipod species, while high hardness and low temperature values seemed to provide protection against chromium toxicity. This experiment showed an appropriate method of adopting ecotoxicological protocols, without neglecting the synergistic and antagonistic effects between polluting substances and physical and chemical environmental factors. (Brunone-PTT) W90-06617

ACID DEPOSITION, SUMMER DROUGHT AND ENHANCED PRODUCTION OF NI-TRATE IN FOREST SOILS; RISK COFACTORS RELATIVE TO FOREST DECLINE, AN ADDI-TIONAL HYPOTHESIS CONCERNING THE SYNERGISTICAL EFFECTS: THE NITROUS ACID CYCLE.

Association pour la Prevention de la Pollution Atmospherique, Bordeaux (France).
For primary bibliographic entry see Field 2B.

EFFECT OF HYDROCARBONS AND DECON-TAMINATING SUBSTANCES ON BACTERIAL FLORA OF COASTAL SEDIMENTS.

Istituto Sperimentale Talassografico,

(Italy).

E. Crisafi, R. Zaccone, L. Genovese, R. LaFerla, and T.L. Maugeri.

Marine Ecology (PSZNI) MAECDR, Vol. 10, No. 4, p 365-375, 1989. 5 fig, 1 tab, 21 ref.

Descriptors: *Biodegradation, *Decontamination, *Hydrocarbons, *Marine sediments, *Microbial degradation, *Oil dispersants, *Oil pollution, *Water pollution effects, *Water pollution treatment, Aerobic bacteria, Bacterial physiology, Fate of pollutants, Heterotrophic bacteria, Oil degradation of the control of the contr

In March 1985, collision between two oil vessels in the Straits of Messina resulted in an oil spill of more than one thousand tons. Following the collimore than one thousand tons. Following the con-sion the local authorities carried out 'clean-up' operations using dispersant substances: Fina-Sol OSR/2, Prodesolv 128/D, Albisol BPD, and TC 66. During 1986, sediments from these areas were examined in order to estimate the effect of both the oil spill and the decontaminating substances. Coast-al sediments were examined in their function as an as sediments were examined in their function as an important link in the chain of the pollutants in the sea. These substances accumulate on reaching the sea-bed and can remain there for long periods before being transformed by benthic organisms. Two surveys for the collection of coastal sediments were carried our with the aim of quantifying ments were carried our with the aim of quantifying the heterotrophic aerobic bacteria and the percentage of those inhibited by dispersants. In addition, the generic composition of the oil degrading fraction was quantified. The investigation has shown no marked quantitative or qualitative alterations in the microbial component. In vitro experiments using three of the five dispersants plus a mixture of all the control of the solvents at various concentrations were performed to gain information on the 'clean-up' effects on the growth and oil degrading capacity of the bacterial genera. The results show that the inhibition of growth differs for the various substances tested and depends on the concentration used. All sub-stances tested appreciably reduced the capacity of the bacteria to utilize hydrocarbons. (Author's abstract) W90-06630

SURVIVAL AND GROWTH TO REPRODUCTIVE MATURITY OF COHO SALMON FOLLOWING EMBRYONIC EXPOSURE TO A MODEL TOXICANT.

Group 5C-Effects Of Pollution

Washington Univ., Seattle. School of Fisheries. R. M. Kocan, and M. L. Landolt. Marine Environmental Research MERSDW, Vol. 27, No. 3/4, p. 177-193, 1989. 3 fig, 6 tab, 31 ref. EPA Grant No. R811348 and NIEHS Grant No.

Descriptors: *Carcinogens, *Growth, *Salmon, *Survival, *Toxicology, *Water pollution effects, Acute toxicity, Cancer, Fish diseases, Migration, N-methyl-N-nitrosoguanidine, Neurofibromas.

In an attempt to determine if fish that survive In an attempt to determine if fish that survive toxicant exposure are competitively disadvantaged relative to unexposed cohorts, coho salmon embryos (27 days old) were subjected to a single, short term (3 hours) dose of waterborne N-methyl-N-nitrosoguanidine (MNNG) (1 microgram/milliter). They were allowed to hatch, and the surviving fish were reared in freshwater hatchery facility ties for six months. At smoltification, most of the fish (>20,000) were released from the hatchery tish (>20,000) were released from the hatchery and allowed to migrate to their natural saltwater feeding grounds; however, a small number (200) were placed in saltwater net pens for one year. In a parallel experiment, 27-day-old embryos were similarly exposed to MNNG ranging from 1-25 micrograms/millitier, but 250 of these fish were retained in freshwater for ten months and never exposed to saltwater. From the groups that were allowed to migrate, the return rate, sex ratio, length, weight and pathological condition of treated fish were not statistically different from untreated fish. Similarly, no difference between treated and control groups was noted when the mortality rate, growth rate, and pathological condition of fish in saltwater net and pathological condition of fish in saltwater net pens was compared. By contrast, fish retained in saltwater pens showed a dose-dependent decrease in size. In addition, 10-65% of the treated fish (versus 0% of the control fish) developed peripher-al nerve neoplasms (neurofibromas). Tumor-bearal nerve neoplasms (neurofibromas). Tumor-bear-ing fish were the same size as control fish, but tumor-free fish were significantly smaller than the control fish. The results of the complete life cycle control tish. The results of the complete life cycle study revealed no competitive disadvantages arising from toxicant exposure; however, the results of the interrupted life cycle study revealed measurable adverse effects. Physiological changes associated with smoltification, parr reversion, and dietary differences are possible explanations for the observed differences in body size and tumor prevalence (Authorizechtens). lence. (Author's abstract)

FACTORS INFLUENCING THE UPTAKE OF TECHNETIUM BY THE BROWN ALGA FUCUS SERRATUS.

Institut Royal des Sciences Naturelles de Belgique, For primary bibliographic entry see Field 5A. W90-06645

EFFECT OF PHYSICAL FACTORS ON THE VERTICAL DISTRIBUTION OF PHYTO-PLANKTON IN EUTROPHIC COASTAL COASTAL

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2L.
W90-06660

PALEOLIMNOLOGICAL EVIDENCE FOR THE RECENT ACIDIFICATION OF LYN HIR, DYFED, WALES. Minnesota Univ., Minneapolis. Limnological Re-

Minnesota Univ., Minneapoiis. Limnological Research Center. S.C. Fritz, A.C. Stevenson, S.T. Patrick, P.G. Appleby, and F. Oldfield. Journal of Paleolimnology, Vol. 2, No. 4, p 245-262, 1989. 2 tab, 9 fig, 53 ref.

Descriptors: *Acid rain effects, *Acidification, *Lake acidification, *Land use, *Limnology, *Paleolimnology, Acid rain, Acidity, Carbon, Diatoms, Fisheries, Lakes, Magnetic studies, Palynology, Sediments, Stratigraphy, Trace metals, Vegetation.

A variety of paleolimnological techniques, coupled with historical data on land-use and fisheries, are

used to evaluate the magnitude, timing, and causes of acidification of Lyn Hir, a moorland lake in central Wales. Reconstruction of pH based on diatom analysis suggests a gradual decline in lakewater pH beginning circa 1870 and intensifying in the mid-1930's, with a total decline of 1.1 pH units between 1870 and 1984. This pH decline correlates with increased sedimentary concentrations of carbonaccous particles. True metals. tions of carbonaceous particles, trace metals, and magnetic minerals, which indicate the local deposition of atmospherically transported products of fossil-fuel combustion. Pollen data and the histori-cal record show no significant alterations in landuse or catchment vegetation, indicating that acidification of Lyn Hir is a result of the increased deposition of atmospheric pollutants, not of landuse and vegetation change. (Author's abstract)

PALEOLIMNOLOGICAL RECONSTRUCTION OF RECENT ACIDITY CHANGES IN FOUR SIERRA NEVADA LAKES.
Indiana Univ. at Bloomington. Dept. of Biology.
M.C. Whiting, D.R. Whitehead, R.W. Holmes, and

S.A. Norton. Jounal of Paleolimnology, Vol. 2, No. 4, p 285-304, 1989, 10 fig, 2 tab, 64 ref. NSF grant BSR-860K 17622.

Descriptors: *Acid rain effects, *Lake acidifica-tion, *Limnology, *Mountain lakes, *Nevada, *Pa-leolimnology, Acidification, Acidity, Diatoms, Lakes, Rain, Stratigraphy.

We have completed a paleolimnological analysis of sediment cores from four lakes in the Sierra Nevada Range of California. The diatom-inferred Nevada Range of California. The diatom-inferred pH profile from Harriet Lake in Yosemite Marional Park (present pH = 6.52) indicates no significant trends over the last 250 years. Inferred pH from Emerald Lake in Sequoia National Park (present pH = 6.10) indicates a very small increase (less than 0.1 pH unit) over the past 60 years and perhaps another small increase (ca. 0.15 pH unit) since 1976. Eastern Brook Lake in Inyo National Forest (present pH = 7.06) shows evidence of both long-term alkalinification (circa 0.3 pH unit over the last 200 years) and pH fluctuations since 1970. Lake 45 in King's Canyon National Park (present pH = 5.16) appears to have acidified slightly (ca. 0.2 pH unit) over the last 60 years. Factors causing the observed trends are uncertain, but a role for acidic deposition cannot be ruled out. (Author's abstract) (Author's abstract) W90-06672

NITROGEN BUDGET IN THE EUPHOTIC ZONE OF LAKE BIWA FROM SPRING TO SUMMER, 1986.

Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 2H. W90-06674

COMPOSITION OF PHOTOSYNTHETIC PRODUCTS IN LAKE BIWA, JAPAN; VERTICAL AND SEASONAL CHANGES AND THEIR RELATION TO ENVIRONMENTAL FACTORS. Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 2H. W90-06675

EFFECT OF DETRITAL ADDITION ON THE DEVELOPMENT OF NANOFLAGELLATES AND BACTERIA IN LAKE KINNERET. Kinneret Limnological Lab., Tiberias (Israel). For primary bibliographic entry see Field 2H. W90-06677

SEA OTTERS AND OIL POLLUTION. Department of Fisheries and Oceans, Vancouver (British Columbia). M. Waldichuk

Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 1, p 10-15, January 1990. 10 ref.

Descriptors: *Oil pollution, *Oil spills, *Otters, *Water pollution effects, Cleanup operations, Marine animals, Marine mammals, Oily water.

Sea otters and how they are affected by oil pollution, a brief history of the sea otter in the North Pacific, the behavior of the sea otter, including how sea otters tend to drape themselves in kelp, are described. The maintenance and reproduction of sea otters in captivity is discussed, with emphasis on how oil spills affect their lives. Several efforts to recolonize sea otters in natural habitats, such as on the coast of British Columbia, Vancouver Island and Southern California, have been ver Island and Southern California, have been made. The effects of the Nestucca and Exxon made. The effects of the Nestucca and Exxon Valdez oil spills are described, as are methods of de-oiling the sea otters. So far, the most effective method of cleaning sea otters of oil pollution is to use 'Dawn' dishwashing detergent. Because sea otters live in colonies, the effects to a total colony following an oil spill can be endangering. Introductions to new colonies can be made without too much difficulty in areas previously inhabited by sea otters. (Male-PTT)

TRANSPORT OF INCINERATED ORGAN-OCHLORINE COMPOUNDS TO AIR, WATER, MICROLAYER, AND ORGANISMS.

Lund Univ. (Sweden). Dept. of Ecology. For primary bibliographic entry see Field 5B. W90-06680

MEDIATORS OF MICROBIOLOGICAL ORIGIN AND EUTROPHICATION PHENOM-

Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France).

Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 1, p 24-29, January 1990. 4 fig, 4 tab, 20 ref.

Descriptors: *Aquatic productivity, *Dystrophy, *Eutrophication, *Pesticides, *Water pollution effects, Algal growth, Detergents, Heavy metals, Marine environment, Marine organisms, Pollutants, Red tide.

Phenomena of eutrophication spread out and advance to phenomena of dystrophy with 'red tides' which can be toxic to marine organisms. In this paper the role of different factors such as elevated paper the role of different factors such as elevated nutrients or temperature in eutrophication are discussed. Many experiments have shown that there are inducing and inhibiting mediators of productivity, which can be modified by certain pollutants (pesticides, detergents, heavy metals). The biological stability of the marine environment is the broken and phenomena of dystrophy can appear. (Author's abstract) W90-06681

EFFECT OF CHLOR-ALKALI INDUSTRY EF-FLUENT ON THE GROWTH AND BIOCHEMI-CAL COMPOSITION OF TWO MARINE MA-

Central Salt and Marine Chemicals Research Inst. Bhavnagar (India).

Bhavhagar (India). A. Tewari, S. Thampan, and H.V. Joshi. Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 1, p 33-38, January 1990. 6 fig, 2 tab, 28 ref.

Descriptors: *Algal growth, *Chemical wastewater, *Marine algae, *Water pollution effects, Algae, Biochemistry, Chlorophyll a, Mercu-

The growth of Ulva fasciata and Codium dwar-kense was least near the chlor-alkali industry outkense was least near the chlor-alkali industry out-fall. Maximum growth of Ulva was furthest away from the outfall and of Codium at intermediate distances. Ash and Hg contents of these species were maximum while Fe was low or least near discharge point. The quantity of protein, carbohy-drate, chlorophyll a, carotenoids in Ulva and pro-tein, lipid and carotenoids in Codium were least near outfall. It seems the metabolism of carbon and nitrogen of these species are inhibited by the discharge. These species can be used as food, as nutritively important constituents are in required quantity and mercury content is much below the maximum permissible limit for human consumption. A direct method of measurement of growth

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

and productivity of seaweeds rather than indirect method (chlorophyll a, etc.) is advisable under the conditions of such pollution. (Author's abstract) W90-06683

HETEROTROPHIC NANNO- AND MICRO-PLANKTON NEAR LARGE SEAPORT CITIES, Akademiya Nauk SSSR, Moscow. Inst. Okeanolo-

gn. A. I. Kopylov, and A. F. Sazhin. Oceanology ONLGAE, Vol. 28, No. 3, p 366-370, Dec 1988. 3 tab, 17 ref.

Descriptors: *Harbors, *Plankton, *Self-purifica-tion, *Water pollution effects, Biomass, Coastal waters, Population dynamics, Species composition.

waters, Population dynamics, Species composition. The degree of development of heterotrophic nanoplankton and microplankton in various ocean harbors is subject to considerable anthropogenic effects. High abundances and biomasses of bacterioplankton were found in all harbors, explaining the presence of considerable concentrations of heterotrophic nanoplankton in these waters, most of which consists of bacteria-consuming protozoans. The doubling time of the population of heterotrophic flagellates measuring less than 10 micrometers ranged from 8.4 to 26.2 h and the hourly production ranged from 0.4 to 15.0 mg/cu m live weight. In addition to protozoans, the nanoheterotropha also include microscopic fungi. The total biomass of nanoheterotrophs which measure less than 10 micrometers and which feed predominantly on bacterioplankton ranged from 16.6 to 358.3 mg/cu m live weight, equivalent to 2.0-31.2% of the biomass of bacterioplankton. Small protozoan organisms consumed between 14.2 and 44.4% of hourly bacterial production. The abundance and biomass hasms consumed between 1-2 and 94.7-30 indurity bacterial production. The abundance and biomass of multicellular microzooplankton, which, in the harbors studied, consisted primarily of crustacean nauplii and rotifers, ranged from 50 to 1000 individuals/L or 39 to 942 mg/cu m live weight. By drawing considerable amounts of bacteria into the trophic chain and simultaneously stimulating bacterial growth, heterotrophic nanoplankton organisms are an extremely important agent of self-purification in inshore marine waters. A clear conception of the composition of the heterotrophic nanoplankton and microplankton and the role of members of these groups in the functioning of planktonic ecosystems should help solve problems in biological self-purification of inshore marine waters. (Male-PTT)
W90-06689 rial growth, heterotrophic nanoplankton org

TRANSFORMATIONS OF NITROGEN FORMS IN EPILIMNION OF EUTROPHIC GLEBOKIE LAKE (MASURIAN LAKE DISTRICT, POLAND).

Polish Academy of Sciences, Lomianki. Inst. Ekologii. For primary bibliographic entry see Field 2H.

DETERMINATION OF THE METABOLIC AC TIVITY OF HETEROTROPHIC BACTERIA ISOLATED FROM ESTUARINE GARDNO LAKE

Wyzsza Szkola Nauczycielska w Słupsku (Poland). Dept. of Ecology and Protection of Environment. For primary bibliographic entry see Field 2H. W90-06692

LABORATORY STUDIES OF THE EFFECT OF AN ANIONIC DETERGENT AND FUEL OIL ON THE LEVELS OF CHLOROPHYLL, OXYGEN AND TOTAL SUSPENDED PARTIC-ULATE MATTER IN WATER OF THE BRDA

Akademia Medyczna, Bydgoszcz (Poland). Dept.

Akadema Necuyesan, of Biology.
G. Drewa, Z. Zbytniewski, D. Andruszczak, B. Kowalska, and V. Korsak.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 36, No. 1, p 161-168, 1989. 16 ref, 6 tab.

Descriptors: *Anions, *Oil pollution, *Rivers, *Water pollution effects, Biomass, Chlorophyll, Detergents, Oil, Oxygen, Plankton, Sulfates.

The effect of anionic detergent, sodium laurylpolyethylene sulfate, and of fuel oil on the levels of he theet of amoin detergent, sommin manylop-lyethylene sulfate, and of fuel oil on the levels of chlorophyll a, oxygen and total suspended particu-late matter (including also the biomass of the phy-toplankton and zooplankton) in water of the Brda River was investigated under laboratory conditions in a 4-week experiment. After 24-h exposure, both the detergent and fuel oil increased the levels of chlorophyll a and of the total suspended particu-late matter. After further exposure, the detergent induced an increase in the levels of chlorophyll a and of the total suspended particulate matter only at a concentration of 0.005 kg/cu m. On the other hand, fuel oil increased the levels of chlorophyll a and of the total suspended particulate matter at all concentrations used. Upon steady aeration there were no substantial differences between the experi-mental and control groups in the water oxygen mental and control groups in the water oxygen content. Oxygen level decreased (despite aeration) only in the aquaria containing the highest concentrations of pollutants. (Author's abstract) W90-06697

SPATIO-TEMPORAL DISTRIBUTION OF PO-

SPATIO-TEMPORAL DISTRIBUTION OF PO-LYCHAETES IN AN ITALIAN COASTAL LAGOON (LAGO FUSARO, NAPLES), Bioservice Soc. Coop., vico S. Domenico Maggio-re 9, 80134 Napoli (Italy). P. Sordino, M. C. Gambi, and G. C. Carrada. Cahiers de Biologie Marine CBIMA5, Vol. 30, No. 3, p 375-391, 1989. 4 fig. 2 tab, 37 ref.

*Coastal Descriptors: *Polychaetes, *Coastal lagoons, *Spatial distribu-tion, *Temporal distribution, *Water pollution effects, Correspondence analysis, Ecosystems, Estua-rine sediments, Italy, Lagoons, Lake Fusaro, Popu-lation dynamics, Seasonal variation.

The spatio-temporal distribution of polychaete populations in an euhaline and polluted lagoon (Lago Fusaro) is discussed. Samples were taken (Lago Pusaro) is discussed. Samples were taken from June 1985 to May 1986 along an inner-outer transect along the lagoon at four stations: two stations were located on hard-bottoms and two on soft-bottoms. A total of 136,962 individuals of posoft-bottoms. A total of 136,962 individuals of polychaetes belonging to 35 species were collected.
Data were analyzed using correspondence analysis.
The dominant taxon was Hydroides elegans.
Brackish water species, typically representative of
reduced and variable salinity environments are
absent. The main environmental feature of the
Fusaro is the high level of anthropogenic eutrophication distributed according to the inner-outer
gradient. Both soft-bottom and hard substrate communities show a variation in species dominances gradient. Both solt-bottom and nard substrate com-munities show a variation in species dominances along an inner-outer gradient which, in turn, is modulated by a seasonal trend. In particular, the polychaete populations of the inner area were strongly reduced in species number during summer periods, particularly in soft-bottoms. In the outer part of the lagoon, the communities were better part of the lagoon, the communities were better structured, due to a more intense water exchange with the sea. As a whole, the composition and dynamics of the polychaete populations in the Fusaro lagoon reflect the environmental character-istics of an euhaline and polluted lagoon and can therefore be considered as good indicators for the interpretation of its ecological conditions. (Author's abstract)

ACUTE TOXICITY OF DISPERSED FRESH AND WEATHERED CRUDE OIL AND DIS-PERSANTS TO DAPHNIA MAGNA.

Toronto Univ. (Ontario). Inst. for Environmental A. M. Bobra, W. Y. Shiu, D. Mackay, and R. H.

Chemosphere CMSHAF, Vol. 19, No. 8/9, p 1199-1222, 1989. 6 fig, 5 tab, 24 ref.

Descriptors: *Daphnia, *Dispersants, *Oil pollution, *Surfactants, *Toxicity, *Water pollution effects, Bioassay, Biological studies, Mathematical

The toxicity of fresh and weathered crude oils and chemical dispersants to Daphnia magna was studied using a novel system which eliminates evaporative losses and maintains oil in emulsified form at 5

and 20 C. Bioassays were conducted for dispersants alone, for water soluble fractions of crude oils obtained at various water/oil ratios, for physical dispersions of crude oils. The results suggest that generally the dispersed oil particles are the primary sources of toxicity, with the dissolved oil and dispersants contributing relatively little toxicity. The toxicity of the oil particles appears to be influenced by particle size and temperature. A mathematical model was prepared and calibrated using these data, and gives a satisfactory representation of the observed toxicity of chemically dispersed oil. (Author's abstract) and 20 C. Bioassays were conducted for disper-

3H-THYMIDINE INCORPORATION: PRELIMINARY INVESTIGATIONS OF A METHOD TO FORECAST THE TOXICITY OF CHEMICALS IN BIODEGRADABILITY TESTS.

ndkvalitetsinstitutet, Hoersholm (Denmark). P. Lindgaard-Jorgensen, and B. Riemann. Chemosphere CMSHAF, Vol. 19, No. 8/9, p 1447-1455, 1989. 1 fig, 2 tab, 16 ref.

Descriptors: *Aquatic bacteria, *Biodegradation, *Fate of pollutants, *Microbial degradation, *Path of pollutants, *Thymidine, *Toxicity, *Wastewater treatment, Activated sludge, Freshwater, Isotopic tracers, Nucleic acids, Phenols, Seawater, Sensitivity analysis, Water pollution effects.

In biodegradability tests it is essential that true In biodegradability tests it is essential that true non-biodegradability can be distinguished from inhibited biodegradability. To this end toxicity tests were performed with 3,5-dichlorophenol and potassium dichromate using the H3-thymidine incorporation methods and three standardized test methods on natural bacterial assemblages from activated sludge, freshwater and seawater. Results showed that eutrophic bacteria towards both test chemicals in the H3-thymidine incorporation methods. Preview oligotrophic bacteria towards both test chemicals in the H3-thymidine incorporation methods. Previous observations of biodegradability of dichlorophenols at the 10-20 mg/L level showing degradability in seawater might be explained by this difference in sensitivity. Compared to available test methods, the H3-thymidine incorporation method proved similar or better in sensitivity, depending on the origin of the bacteria in the test system. The method is inexpensive and easy to perform, shows good reproducibility and can be performed under test conditions that more truly reflect those used in the biodegradability tests. (Geiger-PTT) the biodegradability tests. (Geiger-PTT) W90-06760

PREPARATION OF AQUEOUS MEDIA FOR AQUATIC TOXICITY TESTING OF OILS AND OIL-BASED PRODUCTS: A REVIEW OF THE PUBLISHED LITERATURE.

Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.

A. E. Girling. Chemosphere CMSHAF, Vol. 19, No. 10/11, p 1635-1641, 1989. 1 fig, 1 tab, 40 ref.

Descriptors: *Culture media, *Literature review, *Oil pollution, *Sample preparation, *To *Toxicology, Aquatic life, Chemical analysis.

Published literature has been reviewed with respect to the methods used to prepare aqueous media for use in tests to determine the toxicity of aquatic organisms to oils and formulated oil-based products (OBP). Different methods have been identified which reflect two fundamentally differidentified which reflect two fundamentally different approaches: the whole media approach and the fractional media approach. In the whole media approach media approach media approach media approach media containing a quantity of the OBP is distributed uniformly throughout the water. Whole media methods can be divided into low and high energy media (depending upon the intensity of mixing) and chemically dispersed media. Fractional media is media containing only that fraction of the OBP retained in the aqueous phase after mixing and settlement and can be divided into water-soluble fractions (containing only dissolved OBP components and water-accommodated fractions (containing dissolved and emulsified compo-

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nents). Superimposed upon the different approachnents). Superimposed upon the different approach-es to preparing the test media are inherent differ-ences in the physical and chemical properties of OBPs such as bulk properties, properties of addi-tives, microbial biodegradability, and OBP/water ratio. These properties will also have some bearing on the nature of the final test medium and the methods that can be applied. When determining the toxicity of OBPs to aquatic organisms, considcharacterization and description of the test medium. Failure to do this will not allow an accu-rate assessment of the toxicity to be determined or meaningful comparisons to be drawn. (Geiger-PTT) W90-06766

TOXICOKINETICS OF SELECTED POLYCY-CLIC AROMATIC HYDROCARBONS IN RAIN-BOW TROUT FOLLOWING DIFFERENT ROUTES OF EXPOSURE. Simon Fraser Univ., Burnaby (British Columbia). Environmental Toxicology Program. For primary bibliographic entry see Field 5B. W90-06772

5-METHYL DEOXYCYTIDINE CONTENT OF DNA FROM BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS) EXPOSED TO BENZO(A)PYRENE.

Oak Ridge National Lab., TN. Environmental Sci-

For primary bibliographic entry see Field 5B. W90-06779

BENTHIC INVERTEBRATE BIOASSAYS WITH TOXIC SEDIMENT AND PORE WATER. Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife. For primary bibliographic entry see Field 5A. W90-06783

ASSESSMENT OF INDUSTRIAL SEWAGE IM-PACTS BY ADENYLATE ENERGY CHARGE MEASUREMENTS IN THE BIVALVE CERAS-

TODERMA EDULE.

Laboratorio Nacional de Engenharia e Tecnologia
Industrial, Lisbon (Portugal). Dept. de Estudos de Impacte Industrial.

For primary bibliographic entry see Field 5A. W90-06785

EFFECTS OF PETROLEUM OILS AND THEIR PARAFFINIC, ASPHALTIC, AND AROMATIC FRACTIONS ON PHOTOSYNTHESIS AND RESPIRATION OF MICROALGAE. North-Eastern Hill Univ., Shillong (India). Dept.

A. K. Singh, and J. P. Gaur.

Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 8-16, February 1990. 2 fig, 3 tab, 31 ref.

Descriptors: *Algal physiology, *Bioassay, *Oil pollution, *Toxicity, *Water pollution effects, Chlorophyta, Cyanophyta, Oil fractions, Photo-

Inhibition of photosynthesis was more severe than annionion of photosynthesis was more severe than that of respiration in Anabaena dollollum exposed to Assam crude oil, furnace oil, petrol, diesel, and kerosene. Variabilities in toxicity of these oils, which seem to be related to their aromatic and asphaltic contents, were observed. Diesel and furnace oil, due to greater concentrations of aromatics, were more toxic than other oils. The toxic effects of asphaltic fractions were similar to those of aromatics. The study showed that the effects of a particular fraction vary from oil to oil. Therefore, toxicity of an oil cannot be correctly predicted by mere estimation of its various fractions.

Lower concentrations of Assam crude stimulated photosynthesis and respiration of blue-green algae (cyanobacteria); however, green algae did not show such a response. Stimulation was exerted only by paraffinic fractions of the test oils. (Au-thor's abstract) tract)

EFFECTS OF SALINITY AND TEMPERATURE ON THE TOXICITY OF COPPER TO 1-DAY AND 7-DAY-OLD LARVAE OF HEDISTE (NEREIS) DIVERSICOLOR (O. F. MULLER). Hull Univ. (England). Inst. of Estuarine and Coast-

ar studies.

P. T. E. Ozoh, and N. V. Jones.

Ecotoxicology and Environmental Safety

EESADV, Vol. 19, No. 1, p 24-32, February 1990.

3 tab, 21 ref.

Descriptors: *Annelids, *Bioassay, *Copper, *Synergistic effects, *Water pollution effects, Life stages, Predation, Salinity, Temperature.

The effects of salinity and temperature on the toxicity of copper to 1-day and 7-day-old larvae of Hediste diversicolor were tested using factorial analysis. Mortality of larvae was influenced by analysis. Mortainty of larvae was influenced by salinity, temperature, and copper, but I-day-old larvae were more susceptible than the 7-day-old larvae. Resistance to copper increased with age. Low concentrations of 5 and 20 microg/L copper Low concentrations of 5 and 20 microg/L copper were more inhibitory to 1-day and 7-day old larvae, respectively, than were higher copper levels. The responses of 1-day-old larvae to copper levels from 0 to 20 microg/L and of 7-day-old to copper levels from 0 to 100 microg/L were complex. Increasing salinity 7.6 to 30.5% reduced both copper toxicity and protozoa/bacteria attacks. (Author's abstract)

PHYSIOLOGICAL EFFECTS IN FISH EX-POSED TO EFFLUENTS FROM MILLS WITH SIX DIFFERENT BLEACHING PROCESSES.

Finnish Environmental Research Group, Damm-vagen 6, SF-01600 Vanda, Finland. K.-J. Lehtinen, A. Kierkegaard, E. Jakobsson, and

A. Wandell. A. wanden.

Ecotoxicology and Environmental Safety
EESADV, Vol. 19, No. 1, p 33-46, February 1990.

Z fig. 5 tab, 39 ref. Environmental Research Foundation of the Swedish Pulp and Paper Association, Project SSVL-85.

Descriptors: *Bioassay, *Bleaching wastes, *Pulp and paper industry, *Toxicity, *Water pollution effects, Aerated lagoons, Hematology, Osmoregu-lation, Rainbow trout, Synergistic effects.

Immature rainbow trout (Salmo gairdneri) were continuously exposed in a flow-through system to a total of six different bleached kraft mill effluents at two exposure concentrations (400 and 2000 times dilution) for 7 weeks, during three consecutimes dilution) for 7 weeks, during three consecu-tive years (1982-1984). The fish were exposed in outdoor tanks connected to the outgoing water from a parallel mesocosms study simulating the Baltic littoral (Fucus vesiculosus) zone. After ex-posure, hematological, osmoregulational and mixed function oxidase (MFO) parameters were studied. The results showed that conventional chlorine bleaching, with and without treatment in aerated lagoons, had the strongest effects on the fish exposed. Oxygen prebleaching followed by high (50%) substitution of the active chlorine as chlo-(50%) substitution of the active chlorine as chlorine dioxide, as well as oxygen prebleaching and normal (85%) chlorine levels in the chlorine/chlorine dioxide step and treatment in aerated lagoons, had the fewest effects on the fish. The results imply a complex pattern of effects where the relative prevalence of MFO-stimulating and -inhibiting substances may give different biological results in fish exposed to these kinds of effluents. (Author's abstract) abstract) W90-06788

EFFECTS OF SUBLETHAL CONCENTRA-TIONS OF PHOSPHAMIDON, METHYL PAR-ATHION, DDT, AND LINDANE ON TISSUE NITROGEN METABOLISM IN THE PENAEID PRAWN, METAPENAEUS MONOCEROS (FA-BRICIUS).

Sri Venkateswara Univ., Kavali (India). Div. of l'oxicology.

M. S. Reddy, and K. V. R. Rao.

Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 47-54, February 1990. 4 tab, 32 ref.

Descriptors: *Bioassay, *Bioindicators, *Crustaceans, *Pesticides, *Shrimp, *Toxicity, *Water pollution effects, Ammonia, DDT, Lindane, Methyl parathion, Nitrogen, Phosphamidon, Physiology, Stress, Tissues.

Changes in midgut gland, muscle, and gill tissue nitrogen metabolic profiles were studied in a penaeid prawn, Metapenaeus monoceros, following its exposure to sublethal concentrations of phosphamidon, methyl parathion, DDT, and lindane. In all the pretions of the property of the profile appears are the profiles as th con, metnyl paratinon, DDI, and inicane. In air the pesticide-exposed prawn tissues, ammonia levels were significantly increased and a shift in the nitrogen metabolism toward the synthesis of urea and glutamine was observed. Inhibition of gluta-mate oxidation to ammonia and alpha-ketoglutarate mate oxidation to ammonia and appa-se-ciglitarate by glutamate dehydrogenase suggests a mechanism whereby hyperammonemia is reduced by minimiz-ing the addition of further ammonia to the existing elevated ammonia. Aspartate and alanine aminoelevated ammonia. Aspartate and atanine amino-transferases demonstrated an increase in their ac-tivity levels, suggesting gluconeogenesis. Pesticide-induced stress also seems to induce ammoniagene-sis, which is due to increased deamination of pur-ines. Mechanisms to detoxify the ammonia by en-hancing the synthesis of urea and glutamine were observed in the tissues. (Author's abstract) W90-06789

IN VIVO EFFECT OF THE ORGANOPHOS-PHORUS INSECTICIDE TRICHLORPHON ON THE IMMUNE RESPONSE OF CARP (CY-PRINUS CARPIO). I. EFFECT OF CONTAMI-NATION ON ANTIBODY PRODUCTION IN RELATION TO RESIDUE LEVEL IN ORGANS, Ecole Nationale Veterinaire de Lyon (France). Lab. d'Ecotoxicologie. M. Cossarini-Dunier, A. Demael, and A. K.

Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 93-98, February 1990. 3 fig, 1 tab, 11 ref. CNRS Grant ATP PIREN 950

Descriptors: *Carp, *Fish physiology, *Insecticides, *Toxicology, *Trichlorfon, *Water pollution effects, Acetylcholinesterase, Antibodies, Organs, Yersinia ruckeri vaccine.

The organophosphorus insecticide trichlorphon was tested at medium (10 and 20 ppm) and high concentrations (20,000 ppm) on antibody production against Yersinia ruckeri vaccine. No statistically significant effect was observed on humoral response or on hematocrit. Contamination of organs was analyzed by acetycholinesterase activiorgans was analyzed by acceptonineserase activi-ty. At 20,000 ppm only liver and brain were highly contaminated; spleen and lymphocytes were not significantly contaminated. At 20 ppm no residue was found in organs. (See also W90-06794) (Author's abstract) W90-06793

IN VIVO EFFECT OF THE ORGANOPHOS-PHORUS INSECTICIDE TRICHLORPHON ON IMMUNE RESPONSE OF CARP (CYPRINUS CARPIO). II. EFFECT OF HIGH DOSES OF TRICHLORPHON ON NONSPECIFIC IMMUNE RESPONSE.

Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zabieniec Centre. A. K. Siwicki, M. Cossarini-Dunier, M. Studnicka, and A. Demael.

Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 99-105, February 1990. 6 fig, 1 tab, 17 ref.

Descriptors: *Carp, *Fish physiology, *Insecticides, *Trichlorfon, *Water pollution effects, Immune response, Leukopenia, Lysozymes.

The effect of trichlorphon, one of the most widely used organophosphorus insecticides, on the non-specific immune response in carp (Cyprinus carpio) was studied. The effect of 20,000 ppm trichlorphon was studied. The effect of 20,000 ppm inchiorphon on the immune response was followed for 3 and 56 days after intoxication. The effect of 10,000 ppm trichlorphon on the nonspecific immune response of carp experimentally infected by Pseudomonas alcaligenes and Aeromonas punctata was also ex-

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amined. Leucocyte number, phagocytic ability of neutrophils, percentage nitroblue tetrazolium-positive polymorphonuclear cells, phagocytic index, jysozyme level in serum, and ceruloplasmin activity in plasma were examined on Days 2, 4, 6, 8, 10, 14, 18, 22, and 26 after carp were exposed. After intoxication leukopenia was observed as decreases in phagocytic ability of neutrophils and in phagocytic index. Lysozyme level in serum was also decreased compared to that of control. The percentage of nitroblue tetrazolium-positive polymorcentage of nitroblue tetrazolium-positive polymorcentage of nitroblue tetrazolium-positive polymorcentage. uecreased compared to that of control. The per-centage of nitroblue tetrazolium-positive polymor-phonuclear cells decreased when the ceruloplasmin activity in plasma increased in intoxicated fish. (See also W90-06793) (Author's abstract) W90-06794

TOXICITY OF THE PRETHROID INSECTI-CIDE FENVALERATE TO A FRESH WATER FISH, TILAPIA MOSSAMBICA (PETERS): CHANGES IN GLYCOGEN METABOLISM OF MUSCLE.

Sri Venkateswara Coll., New Delhi (India). Dept. of Zoology. V. Radhaiah, and K. J. Rao.

Ecotoxicology and Environmental Safety EESADV, Vol. 19, No. 1, p 116-121, February 1990. 4 fig, 2 tab, 25 ref.

Descriptors: *Bioassay, *Fenvalerate, *Fish physiology, *Insecticides, *Tilapia, *Toxicity, *Water pollution effects, Enzymes, Glycogen, Metabolism, Muscle.

Toxic effects of a pyrethroid insecticide, fenvalerate, on fish muscle glycogen metabolism were investigated. Estimations were made after 10 and 20 days of exposure, and altered muscle glycogen metabolism was observed. The changes included a significant (P<0.001) decrease in the levels of glycogen, pyruvate, maleate dehydrogenase (MDH), succinate dehydrogenase (SDH), and phosphorylase a, b, and ab activities, while elevated levels of lactic acid, aldolase, and lactate dehydrogenase (LDH) activity were observed under fenvalerate intoxication. There was a decrease in opercular movement and oxygen consumption with an increase in concentration of fenvalerate. (Author's abstract) abstract) W90-06796

EFFECTS OF WATER REUSE ON LAKE

TROUT.
Fish and Wildlife Service, Bozeman, MT. Fish
Technology Center.
E. MacConnell.

Progressive Fish Culturist PFCUAY, Vol. 51, No. 1, p 33-37, January 1989. 2 fig. 1 tab, 16 ref.

Descriptors: *Fish hatcheries, *Trout, *Water reuse, Ammonia, Dissolved oxygen, Growth.

Lake trout (Salvelinus namaycush) were reared in water reused through a series of seven tanks for a period of 150 days. Fish loading per tank was based on a flow index of 0.71, giving a cumulative index of 4.97 after the seventh water use. Dissolved oxygen and total ammonia were measured as indicators of water quality. Average dissolved oxygen concentration decreased from 7.6 ppm after the first water use to 3.1 ppm after the seventh use, and average ammonia concentration increased from 0.09 ppm after the first use to 0.94 ppm after the seventh use. Lake trout growth rate began to decline at the fifth water use when dissolved oxygen averaged 3.5 ppm and ammonia 0.75 ppm. (Author's abstract) Lake trout (Salvelinus namaycush) were reared in

CHANGES IN T-LYMPHOCYTE DISTRIBUTION ASSOCIATED WITH INGESTION OF ALDICARB-CONTAMINATED DRINKING WATER: A FOLLOW-UP STUDY. Centers for Disease Control, Atlanta, GA. Epidemiology Program Office.

1. R. Mirkin, H. A. Anderson, L. Hanrahan, R. Hong, and R. Golubjatnikov.
Environmental Research ENVRAL, Vol. 51, No. 1, p 35-50, February 1990. 4 fig, 7 tab, 23 ref.

Descriptors: *Aldicarb, *Groundwater pollution, *Pesticides, *Public health, *Toxicology, *Water

pollution effects, Drinking water contamination, Lymphocytes, T-cells, Wisconsin.

Lymphocytes, T-cells, Wisconsin.

The carbamate pesticide, aldicarb, is the most commonly found man-made groundwater contaminant in Wisconsin. A 1985 study linked ingestion of aldicarb-contaminated drinking water with altered T-cell distributions, specifically an increase in the mean number of CD8+(T8) T cells. To further evaluate this finding, a follow-up study was done in 1987. Of the 50 Portage County, Wisconsin, women who participated in the filts study, 45 participated in the follow-up: 18 formerly exposed and 27 formerly unexposed. In our follow-up, only 5 women were found to be currently exposed to aldicarb. This group of 5 women, compared to 39 unexposed women who had peripheral blood specimens taken, had an increased percentage of lymphocytes and an increased number of CD2+T cells. Although the number of exposed persons was small, the increases in percentage lymphocytes and absolute numbers of CD2+ and CD8+T cells were consistent with a dose-response relationship. No identified drinking water contaminant other than aldicarb could explain these findings. These results support earlier evidence linking aldicarb exposure and lymphocyte distribution changes. Although adverse clinical effects have not been documented, the widespread use of this chemical and consequent potential for widespread exposure indicate a clear need for further research on this issue. (Author's abstract)

UNDERSTANDING THE RESPONSE TO ENVI-RONMENTAL RISK INFORMATION.
Illinois Univ. at Urbana-Champaign. Inst. for Envi-

ronmental Studies.
For primary bibliographic entry see Field 6B.
W90-06908

ENVIRONMENTAL CHEMISTRY AND TOXI-COLOGY OF ALUMINUM. For primary bibliographic entry see Field 5B. W90-06529

CHRONIC NO-OBSERVED-EFFECT CONCEN-TRATIONS OF ALUMINUM FOR BROOK TROUT EXPOSED IN LOW-CALCIUM, DILUTE ACIDIC WATER. National Fisheries Contaminant Research Center,

Columbia, MO. L. Cleveland, E. E. Little, R. H. Wiedmeyer, and

D. R. Buckler.

IN: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan.

1989. p 229-246, 1 fig, 8 tab, 29 ref.

Descriptors: *Acid rain, *Acidic water, *Aluminum, *Chronic toxicity, *Toxicology, *Trout, *Water chemistry, Absorption, Aquatic life, Calcium, Chemical analysis, Chemical interactions, En wironmental effects, Filtration, Hydrogen ion con-centration, Metal complexes, Resources manage-ment, Speciation, Water quality.

Although the chemistry of aluminum (Al) in dilute acidic waters is reasonably well understood, further research is needed on the various forms of Al that exist under certain conditions and the interactive effects of acidity and Al on aquatic organisms. A study was conducted to determine the chronic no-observed-effect concentrations of Al for brook no-observed-effect concentrations of Al for brook trout exposed in low-calcium, dilute acidic water and to examine the speciation of Al during the exposures. Analyses of water samples from each treatment showed that the concentrations of total dissolved Al and total dissolved monomeric Al remained nearly constant over the entire range of Al treatments. The measurement of total dissolved All treatments. The measurement of total utsolved (filtered), and readily reactive (extractable) monomeric and polymeric species of Al would yield a good estimate of the amount of toxic Al present in natural waters. The results of whole-body Al resinatural waters. Ine resuits of whole-body Ai resi-due analyses imply that as brook trout advanced from larvae to juveniles they began either to de-crease their rate of Al uptake or to eliminate Al at a rate that exceeded uptake. Acidity, length of exposure, and the biological endpoint measured are

critical factors in determining chronic no-effect concentrations of Al for fish inhabiting dilute acidic waters. The ability of brook trout to hatch was the earliest and most sensitive index of Al was the earliest and most sensitive index of Al toxicity in both exposures of pH 5.6-5.7 and pH 6.5-6.6. Because Al is a ubiquitous, naturally-occurring element, resource managers should be aware of environmental variables (e.g., pH) that mobilize or exacerbate the toxic effects of Al. Assessments of site-specific problems of Al contamination must consider that water quality can greatly influence Al toxicity. (See also W90-06929) (Fish-PTT) W90-06940

COMPOSITION AND CONSEQUENCES OF ALUMINUM IN WATER, BEVERAGES AND OTHER INGESTIBLES.

Bjorksten Research Foundation, Madison, WI. For primary bibliographic entry see Field 5B. W90-06941

EFFECT OF APPLICATIONS OF SEWAGE SLUDGE ON N, P, K, CA, MG AND TRACE ELEMENTS CONTENTS OF PLANT TISSUES. Institut National de la Recherche Scientifique, Sainte-Foy (Quebec). For primary bibliographic entry see Field 5E. W90-06974

MACROALGAE AND PHYTOPLANKTON STANDING CROPS IN THE CENTRAL VENICE LAGOON: PRIMARY PRODUCTION AND NUTRIENT BALANCE.

Venice Univ. (Italy). Dept. of Environmental Sci-

ence.
A. Sfriso, B. Pavoni, and A. Macromini.
Science of the Total Environment STENDL, Vol.
80, No. 2/3, p 139-159, May 1989, 7 fig, 6 tab, 44
ref. Italian Council for Research (CNR) Grant
86.01727.03.

Descriptors: *Algal growth, *Biomass, *Eutrophication, *Macrophytes, *Marine algae, *Nutrient concentrations, *Phytoplankton, *Primary productivity, *Standing crops, Chlorophyll a, Italy, Nitrogen, Phosphorus, Venice Lagoon.

Biomass measurements carried out in the central part of the Venice lagoon during the season of the highest macroalgal production, at the beginning of June 1987, showed that 85 square kilometers, corresponding to 65 percent of the examined area, were covered by remarkable amounts of nitrophile macroalgae. Total macroalgae biomass was 546,900 tons, accounting for 17,679 tons of carbon, 1911 tons of nitrogen, and 170 tons of phosphorus. The annual net primary production, calculated from the maximum production/biomass (P/B) ratio determined in a hypertrophic area of the central lagoon, was estimated to be between 866,160 and 1,154,880 tons. Therefore, in Spring-Summer, macroalgae recycled 78 to 104 percent Biomass measurements carried out in the central 866,160 and 1,154,880 tons. Therefore, in Spring-Summer, macroalgae recycled 78 to 104 percent and 38 to 51 percent of the total annual nitrogen and phosphorus which entered the central lagoon. Phytoplankton standing crop appeared negligible in most of the studied area. High chlorophyll-a concentrations were only measured near the Porto Marghera industrial zone where macroalgae were almost absent; in the area between the islands of South Angelo and Gidecca, where the water depth was greater than one meter, and in the area facing the island of Lido used by the Municipality of Venice as a test area for algal removal experiments. Based on both space and time measurements, nanoplankton accounted for about 80 percent of the total phytoplankton. (Author's abstract)

FLUORINE VARIATIONS IN WELSH STREAMS AND SOIL WATERS.

stitute of Hydrology, Wallingford (England). C. Neal.

Science of the Total Environment STENDL, Vol. 80, No. 2/3, p 213-223, May 1989. 5 fig, 4 tab, 28

Descriptors: *Acid rain effects, *Acid streams, *Acidification, *Aluminum, *Chemical speciation,

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*Fluorine, *Model studies, *Soil water, *Streams, *Wales, Catchment areas.

Stream and soil water fluoride concentrations, for acidic acidifying Welsh catchments subject to various forms of land u.e, vary between 0.02 and 0.22 mg/L. Highest concentrations occur within the lower soil zone waters, although stream water concentrations are also high under the condition where atmospheric fluorine inputs are high. Speciation studies show that aluminum fluoride complexes make up a significant proportion of the total aluminum and fluorine concentrations in solution. For both toxicological and solubility studies, fluo-rine measurements need to be made to assess the degree of fluorine complexation in waters associat-ed with acid-imparted Welsh catchments. (Author's abstract) W90-06979

AQUATIC TOXICOLOGY. Virginia Polytechnic Inst. and State Univ., Blacks-burg. Center for Environmental and Hazardous Material Studies.

For primary bibliographic entry see Field 5B. W90-06990

IMPACT OF THE GREENHOUSE EFFECT ON SEWERAGE SYSTEMS: LUND CASE STUDY. Lund Univ. (Sweden). Dept. of Water Resources

Engineering.

J. Niemczynowicz.

Hydrological Sciences Journal HSJODN, Vol. 34,
No. 6, p 651-666, December 1989. 6 fig. 3 tab. 21

Descriptors: "Flood damage, "Global warming, "Greenhouse effect, "Rainfall-runoff relationships, "Runoff forecasting, "Sewer systems, "Storm runoff, "Storm-overflow sewers, "Sweden, "Urban hydrology, "Urban runoff, Conduits, Construction costs, Flood prevention, Flooding, Floods, Overland flow, Rainfall, Storm water, Surface water, Urban drainage, Water conveyance.

The possible impacts of modifications in rainfall patterns due to the greenhouse effect on the funcpatterns due to the greenhouse effect on the func-tion of a sewerage system were studied based on a case study of the city of Lund, Sweden. The Storm Water Management Model is used to simulate changes in the runoff pattern. The stormwater system in Lund is designed for further develop-ment of the city, and thus some parts of the system are overdesigned. Increases of rainfall intensity by 20 and 30% bring significant flooding problems to the city's sewerage network. More than 50% of the city center areas and 6.820 m of conduits are the city center areas and 6,820 m of conduits are flooded when the yearly rainfall is increased by 30%. However, in reality, the total volume capac-ity of the system was not used in the simulations. Surplus water volumes that reach the receiving waters by surface runoff amount to 20% of the rainfall volume during such an event, i.e., about 120,000,000 cu m of water are disposed of by surface flow. This can increase pollution problems due to the washoff of pollutants from the permeable surface and create erosion. To avoid flooding, about 3,000 m of new conduits must be constructed. The costs of constructing new conduits in Lund, assuming as average cost of 2,600 SKR/m conduit, would be about 20 million SKr. Expanding these costs to apply to the total country yields a figure of 3.5 billion SKr. Also, flooding of basements and streets would lead to costs involved with losses of and the damage to private and public property. One of the possible technical measures that can be taken is to increase the use of alterna-tive designs of new stormwater and sewerage systems, involving, for example, detention facilities and infiltration basins located high upstream of the urban catchments. (Friedmann-PTT)

IMPORTANCE OF BIOASSAY VOLUME IN TOXICITY TESTS USING ALGAE AND AQUATIC INVERTEBRATES.

Nova Scotia Agricultural Coll., Truro. Environ-mental Microbiology Lab. G. W. Stratton, and J. Giles. Bulletin of Environmental Contamination and

Toxicology BECTA6, Vol. 44, No. 3, p 420-427, March 1990. 4 fig, 15 ref.

Descriptors: *Bioassay, *Bioindicators, *Chlorella, *Daphnia, *Experimental design, *Testing procedures, *Toxicity, *Water pollution effects, Atrazine, Chlorophyta, Herbicides, Permethrins, Pesticide toxicity, Photosynthesis, Sublethal effects.

Lack of uniformity between aquatic toxicity bioas-say results obtained from different laboratories say resurts obtained from different laboratories may be due, in part to differences in total test volume. The unicellular green alga Chlorella pyreniodosa and the freshwater cladoceran Daphnia magna were used as test organisms. The effects of varying the bioassay volume and total cell numbers on the toxicity of atrazine towards photosynthesis in C. pyreniodosa were determined. A logarithmic relationship between exposure values and percent inhibition was seen, and 50% inhibition of photosynthesis (EE50) was calculated as 12.5 micrograms of atrazine per 1,000,000 cells. Calculated EE50 values ranged from 6.1 to 23.1 micrograms atrazine per 1,000,000 cells. In analyzing the effect atrazine per 1,000,000 cells. In analyzing the effect of bioassay volume on the toxicity of permethrin towards juvenile D. magna, a logarithmic relationship was again obtained. The LE50 (exposure causing 50% immobilization) was calculated as 6.4 ng of permethrin per Daphnia (range of 2.9 to 8.0). 48-hour LC50s (concentrations letal to 50%) for bioassays in 150 and 300 mL volumes were 1.06 pp. and 0.43 npt. respectively, while their respecpb and 0.43 ppb, respectively, while their respec-tive LE50s were 15.9 ng/Daphnia and 12.9 ng/ Daphnia. In studying the effects of bioassay volume on the toxicity of DDT towards juvenile D. magna, the possible influence of total glass surface area (a factor in pesticide binding to glass) was also investigated. Although the LC50 values was also investigated. Anthough the LE50 values did not differ significantly, the LE50 values did. These data indicate that surface area, as well as total volume should be standardized in aquatic bioassays. Exposure has been shown to be the important criterion in bioassays and is dependent upon both the bioassay volume and the number of test organisms. (VerNooy-PTT) W90-07029

PHYSIOLOGICAL RESPONSES OF JUVE-NILE WHITE MULLET, MUGIL CUREMA, EX-

NILE WHITE MULLET, MUGIL CUREMA, EX-POSED TO BENZENE. Instituto Venezolano Tecnologico del Petroleo, Caracas. Dept. of General Engineering. M. Correa, and H. I. Garcia. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 428-434, March 1990. 4 fig, 17 ref.

Descriptors: *Benzenes, *Fish physiology, *Mullet, *Respiration, *Toxicity, *Water pollution effects, Bioassay, Fish toxins, Hydrocarbons, Lethal limit, Median tolerance limit, Metabolism, Morbidity, Mortality, Oil spills, Sublethal effects, Teorical experient. Tropical regions

The potential effects on aquatic organisms of water-soluble aromatic hydrocarbons contained in refined and crude oil have increased in recent years, however most of the studies have focused on the impact of aromatic hydrocarbons in temper-ate marine and freshwater species. An investigation was designed to determine some physiological re-sponses of the tropical white mullet (Mugil sponses of the tropical white mulier (Mugii curema), to benzene stress. Juvenile specimens were collected by seining from beaches in eastern Venezuela (Cumana). Oxygen consumption rates of individual fish were monitored for 24 hours during exposure to 0, 1.00, 5.00, and 10.00 mg/L burning exposure to 0, 1.00, 3.00, and 1.00 mg/L benzene in a flow through system. The 48-hour LC50 was 22 mg/L. Highly significant differences in respiration rates (p < 0.01) were found between control and sublethal benzene concentrations in Mugil curema. Ammonia excretion rates in M. curema decreased with increased benzene concentration (p < 0.01); a 40% reduction in excretion was observed in fish exposed to 10 mg/L benzene. (VerNooy-PTT) W90-07030

SUBLETHAL EFFECTS OF MALATHION ON CHANNEL CATFISH, ICTALURUS PUNCTA-

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.

Aquacutures.

N. Areechon, and J. A. Plumb.

Bulletin of Environmental Contamination and

Toxicology BECTA6, Vol. 44, No. 3, p 435-442,

March 1990. 2 tab, 3 fig. 17 ref.

Descriptors: *Blood, *Catfish, *Malathion, *Pesticide toxicity, *Sublethal effects, *Toxicity, *Water pollution effects, Animal tissues, Bioassay, Fish pathology, Gills, Morbidity, Tissue analysis.

The widely used pesticide malathion is an organophosphate which has been shown to affect the hematology of fish. Groups of 100 Channel catfish fingerlings (averaging 16.5 cm and 26.8 g) were exposed either to 0 (control) or 4.5 mg/L malathion (as active ingredient) for 96 hours. Blood was collected from 20 fish at 12, 24, 48, 72, and 96 hours after exposure. Exposed fish appeared to lose equilibrium and direction of movement, and about 80% developed vertebral deformities. Exposed fish ad significantly (n < 0.05) increased numbers of 80% developed vertebral deformities. Exposed fish had significantly (p < 0.05) increased numbers of erythrocytes and decreased numbers of leukocytes at 48, 72, and 96 hours after exposure. Plasma glucose of the exposed fish was significantly higher than that of the controls throughout the sampling period. Epithelium of the gill lamellae of treated fish became necrotic and began to slough from the supporting structures. The liver also appeared ne-crotic, but no other significant histopathology was observed. Results indicate that malathion does affect blood components especially by increasing affect blood components especially by increasing affect blood components especially by increasing the hematological component of channel catfish erythrocytes and decreasing leukocytes. (Ver-W90-07031

EFFECT OF ENDOSULFAN ON ACID AND ALKALINE PHOSPHATASE ACTIVITY IN LIVER, KIDNEY, AND MUSCLES OF CHANNA GACHUA.

Jiwaji Univ., Gwalior (India). School of Studies in

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 443-448, March 1990. 3 tab, 13 ref.

Descriptors: *Biochemical analysis, *Endosulfan, *Fish physiology, *Pesticide toxicity, *Pesticides, *Phosphatases, *Water pollution effects, Animal tissues, Bioassay, Channa, Chlorinated hydrocarbons, Enzymes, Kidneys, Liver, Muscle, Sublethal

The effect of endosulfan, a moderately hazardous organochlorine insecticide, on the activity of acid and alkaline phosphatase in liver, kidney and muscles of a freshwater teleost was studied. Groups of 20 Channa gachua were exposed to 0.0022, 0.0037, and 0.0056 mg endosulfan/L for 15 or 30 days. Fish showed a slight increase in acid phosphatase activity in liver and kidney after 15 days at 0.0022 mg/L of endosulfan. The enzyme activity was significantly inhibited at 0.0056 mg/L of endosulfan after 15 days exposure in liver (maximum inhibition of 55.2%), kidney (60.3%) and muscles (62.1%). After 30 days, enzyme activity was further reduced by 69.9%, 79.6% and 65.5%, respectively. The enzyme activity of alkaline phosphatase was activated at 0.0022 mg/L after 15 days by 5.8% in liver. However, at 0.0056 mg/L, liver enzyme activity decreased significantly (p < 0.01) after the same 15-day exposure period. A gradual reduction in enzyme activity with increasing concentration and exposure time was observed. A significant inhibition (p < 0.01) was seen in all the three tissues at both concentrations (0.0022 and 0.0037 mg/L) of endosulfan after 30 days of exposure. (VerNooy-PTT) The effect of endosulfan, a moderately hazardous

CALMODULIN CONCENTRATION IN MUCUS OF RAINBOW TROUT, SALMO GAIRDNERI, EXPOSED TO COMBINATIONS OF ACID, ALUMINUM, AND CALCIUM.

Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV.

T. E. Lewis, S. Yuan, and A. Haug.

Effects Of Pollution-Group 5C

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 449-455, March 1990. 2 tab, 25 ref.

Descriptors: *Acid rain effects, *Acidic water, *Aluminum, *Biochemical tests, *Bioindicators, *Calcium, *Mucus, *Proteins, *Trout, *Water pollution effects, Bioassay, Calmodulin, Fish, Hydrogen ion concentration, Iodine radioisotopes, Sublethal effects, Toxicity.

The presence of calmodulin (CaM), a calcium-regulating protein which selectively binds inorganregulating protein which selectively offines in long and ic monomeric aluminum, has been reported in fish gills and mucus. Groups of 2.5 year old rainbow trout (Salmo gairdneri) were exposed to one of seven combinations of pH (4.80 to 6.50), calcium (1 to 4 mg/L) and aluminum (Al, 1.8 to 97.3 micro-grams/L) for 147 days. A CaM I125 radioimmungrams/L) for 14/ days. A CaM 1125 radioimmun-oassay was run on mucus collected from the fish at the end of the exposure period. The CaM content in mucus collected from fish exposed to Al was generally greater than that from those not exposed to Al. In mucus derived from Al-exposed fish, the total protein concentration was less than in mucus from non-exposed fish, although the micrograms from non-exposed fish, although the micrograms CaM per mg total protein was greater in exposed fish. Slightly less CaM was present in the mucus of fish held at low Ca levels (1 mg/L), however, only 2 fish were tested. The one specimen available for CaM determination at the 100 micrograms/L Al level had the greatest Al exposure, however, no Al (< 10 micrograms/L) was detected in the CaM fraction. Changes in protein content in Al stressed fraction. Changes in protein content in Al stressed fish suggests that the enhanced presence of calmohas suggests that the enhanced presence of camodulin in mucus may be a response to Al stress for the purpose of maintaining membrane integrity and regulatory processes in epithelial cells. These pre-liminary data suggest that the presence of calmodulin in fish mucus may serve as an indicator of stress induced by biologically active Al in surface waters. Further study is in progress to verify these findings. (VerNooy-PTT)
W90-07033

IN VITRO CYTOTOXICITIES OF INORGANIC LEAD AND DI AND TRIALKYL LEAD COMPOUNDS TO FISH CELLS,

Rockefeller Univ., New York. Lab. Animal Research Center. H. Babich, and E. Borenfreund.

H. Babicii, and E. Borenteaud.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 456-460, March 1990. 1 fig, 2 tab, 11 ref. EPA Grant

Descriptors: *Animal tissues, *Fins, *In vitro tests, *Lead, *Organometals, *Sunfish, *Toxicity, *Water pollution effects, Bioassay, Fish, Heavy metals, Laboratory methods, Morbidity, Sublethal effects, Tissue analysis.

Although there has been much research on the effects of inorganic lead (Pb(++)) on the aquatic blota, less is known on the environmental impact of organolead compounds. Epithelioid cells (BG/F cell line) from fin tissue of bluegill sunfish (Lepocell line) from in tissue of bluegill suntist (Lepo-mis macrochirus) fingerlings were exposed to or-ganolead compounds in the 24 hour neutral red assay. This assay quantitates the number of viable, uninjured cells after their exposure to toxicant and is based on the uptake and accumulation in lyso-somes of the supravital dye, neutral red. Cell numbers are determined by correlation with spectro-photometric values. The sequence of cytotoxicity photometric values. The sequence of cytotoxicity was triethyl lead cation > trimethyl lead cation > dimethyl lead cation > lead (Pb(++)). The NR-50 (concentration at which only 50% of cells are able to uptake red dye) was 62.2 micrograms lead/L for diethyl lead, 6.2 for dimethyl lead, 2.3 for trimethyl lead, and 0.9 for dimethyl lead, 2.3 for trimethyl lead, and 0.9 for triethyl lead. This correlates well with in vivo fish toxicity data. 24 hour NR-50 values were also determined for lead nitrate (400 micromoles), diethyl lead chloride (300 micromoles), dimethyl lead chloride (30 micromoles), trimethyl lead acetate (11 micromoles), triethyl lead acetate (4.4 micromoles), (18 NISE) PETT cromoles). (VerNooy-PTT) W90-07034

GROWTH, PHOTOSYNTHESIS AND NITROGEN FIXATION OF ANABAENA DOLIOLUM EXPOSED TO ASSAM CRUDE EXTRACT. North-Eastern Hill Univ., Shillong (India). Dept.

of Botany. J. P. Gaur, and A. K. Singh.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 494-500, March 1990. 6 tab, 18 ref.

Descriptors: *Algal growth, *Anabaena, *Cyano-phyta, *Oil pollution, *Toxicity, *Water pollution effects, Bioassay, Hydrocarbons, Morbidity, Nitro-gen fixation, Photosynthesis, Sublethal effects.

Few studies have addressed the effect of petroleum contaminants on heterocystous blue-green algae (cyanobacteria), which can fix N2 and are impor-(cyanobacteria), which can fix N2 and are impor-tant in aquatic ecosystems. The influence of Assam-crude oil on growth, photosynthesis (C14 incorpo-ration), nitrogen fixation (nitrogenase activity) and heterocyst differentiation in Anabaena doliolum was examined. Cultures of A. doliolum were ex-posed to media containing 0, 20, 40, 60, 80% and 100% (12.7 mg/L. oil) aqueous crude oil extracts (ACOEs) of sterilized Assam crude from Gauhati Refinery, India. The test oil inhibited the growth Refinery, India. The test oil inhibited the growth of algae in a concentration-dependent manner. Oil stimulated C14 uptake at 20% saturation level during 30 minutes of incubation, but prolonged during 30 minutes of incubation, but prolonged incubation was inhibitory. After inhibition of C14 uptake for up to 9 days in 20, 40, and 60% ACOE, gradual improvement in C14 uptake occurred; whereas declining trends were maintained in 80 and 100% ACOE. Inhibition of nitrogenase activity occurred in long-term (up to 15 days) experiments. ACOE inhibited heterocyst differentiation in A. doliolum and this could be one of the reasons for inhibition of nitrogenase activity. It is difficult to pinpoint the toxic constituents of ACOE, but paraffinic and aromatic hydrocarbons are the to pinpoint the toxic constituents of ACUE, but paraffinic and aromatic hydrocarbons are the major water-soluble toxic components of some other oils. Other heterocystous cyanobacteria may also be deleteriously affected by Assam crude and similar type of oils. (VerNooy-PTT) W90-07040

ASSESSING MICROBIAL TOXICITY OF 2-ETHOXYETHANOL AND BIS(2-CHLOR-OETHYL) ETHER BY A MODIFIED SPREAD

Texas Univ. Health Science Center at Houston. School of Public Health.

For primary bibliographic entry see Field 5D. W90-07053

ALTERED BRAIN CATECHOLAMINE LEVELS IN RAINBOW TROUT (SALMO GAIRDNERI RICHARDSON) EXPOSED TO DIETHYLDITHIOCARBAMATE AND AMYLX-

ANITALE.

Uppsala Univ. (Sweden). Dept. of Zoophysiology.

M. Block, and G. E. Nilsson.

Aquatic Toxicology AQTODG, Vol. 16, No. 1, p
1-8, January 1990. 3 fig. 1 tab, 23 ref.

Descriptors: *Dithiocarbamates, *Fish physiology, *Toxicity, *Trout, *Water pollution effects, *Xanthates, Amylkanthate, Catecholamines, Diethyldithiocarbamate, Enzymes, Metal complexes, Norepinephrine, Teratogenic effects.

Complexing agents are extensively used in industri-al processes. Xanthates and dithiocarbamates form hydrophobic complexes with heavy metals, and increase bioavailability of these heavy metals, causing potential risks to reproduction, growth and survival. Rainbow trout were exposed to 0.5 or 5.0 micromoles of diethyldithiccarbamate (DDC) or micromoles of diethyldithiocarbamate (DDC) or amylxanthate (AX) for 24 hours. Both concentra-tions of DDC were found to decrease the brain-level of norepinephrine and increase the brain-level of dopamine. This suggests an inhibition of dopa-mine-beta-hydroxylase, the enzyme synthesizing norepinephrine from dopamine. Also 5 micromoles AX was found to decrease the level of norepineph-rine. Neither DDC or AX had any significant effect on the brain-level of serotonin. (Author's abstract) abstract) W90-07085

PITUITARY RESPONSE TO CADMIUM DURING THE EARLY DEVELOPMENT OF TI-LAPIA (OREOCHROMIS MOSSAMBICUS). Katholieke Univ. Nijmegen (Netherlands). Dept.

of Animal Physiology. H. Fu, and R. A. C. Lock.

Aquatic Toxicology AQTODG, Vol. 16, No. 1, p 9-18, January 1990. 4 fig. 1 tab, 39 ref.

Descriptors: *Cadmium, *Fish physiology, *Hormones, *Immunochemistry, *Tilapia, *Toxicity, *Water pollution effects, Adrenocorticotropin, Embryonic growth stage, Heavy metals, Ion balance, Pituitary, Prolactin.

The pituitary hormones prolactin and adrenocorticotropin regulate water and ion balance in fish. Exposure to cadmium may often disrupt this ion Exposure to cadmium may often disrupt this ion balance by inhibiting branchial calcium uptake. Immunocytochemical and morphometric methods were applied to study the response of the pituitary to cadmium during the early development of tilapia (Oreochromis mossambicus). The affinity of prolaction (PRL) cells and adrenocorticotropic hormone (ACTH) cells for immunocytochemical staining and percentage of the pituitary volume occupied by these cells (fractional volume) were used as criteria for their activity and related to survival and to tissue sodium, potassium, calcium, and water content. Exposure of embryos to cadmium led, between 144 hours and 288 hours after fertilization, to a higher staining density and a significant (P<0.01) increase in fractional volume of PRL cells, indicating a higher synthesizing caof PRL cells, indicating a higher synthesizing capacity. No such changes were observed for ACTH cells during the experimental period. Immediately after hatching a significant drop in survival (P<0.05) and tissue calcium content (P<0.01) was observed in cadmium-exposed larvae, followed by complete recovery around 216 hours and 288 hours respectively. This recovery was concomitant with an apparent increase in the synthesizing capacity of PRL cat a very early stage of development to counteract adverse effects of cadmium. (Author's abstract) abstract) W90-07086

PHARMACOKINETICS AND METABOLISM OF TRICLOPYR BUTOXYETHYL ESTER IN COHO SALMON.

Dow Chemical U.S.A., Midland, MI. Mammalian and Environmental Toxicology Research Lab.
M. G. Barron, M. A. Mayes, P. G. Murphy, and R.
J. Nolan.

Aquatic Toxicology AQTODG, Vol. 16, No. 1, p 19-32, January 1990. 5 fig, 3 tab, 27 ref.

Descriptors: *Biotransformation, *Fish physiology, *Herbicides, *Metabolism, *Pharmacokinetics, *Salmon, *Toxicity, *Toxicology, *Water pollution effects, Elimination, Enzymes, Mathematical models, Mortality, Pollutant effects, Storage, Tri-

The pharmacokinetics and metabolism of triclopyr The pharmacokinetics and metabolism of triclopyr butoxyethyl ester (BEE), a toxic element of the herbicide Garlon, were studied in yolk-sac fry of the coho salmon (Oncorhynchus kisutch). Triclopyr BEE was rapidly absorbed from water, then rapidly de-esterified by the fish, which limited triclopyr BEE accumulation. Triclopyr acid was the principal metabolite observed in fish and exposure water, and was the principal residue in fish. A compartmental model describing the dynamics of triclopyr BEE and acid in fish and water allowed prediction of ester accumulation under various expediction of ester accumulation under various exprediction of ester accumulation under various exprediction of ester accumulation under various ex-posure regimes. The model indicated that a small fraction of ester escaping metabolism was trans-ferred to a peripheral storage compartment. The slower terminal elimination of triclopyr BEE was due to transfer of ester back into the metabolisc compartment, rather than slow metabolism. Exposure to triclopyr BEE in the presence of a carboxy-lesterase inhibitor had no effect on toxicity or total residue levels in the fish, but ester concentrations in the fish increased by seven times. The observed lack of change in triclopyr acid levels during esterase inhibition was predicted by the pharmacokine-tic model, and indicated that mortality resulted

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from lethal tissue concentrations of triclopyr acid or total residues. (Author's abstract) W90-07087

CADMIUM RESISTANCE IN DAPHNIA

Utrecht Rijksuniversiteit (Netherlands). Research Orrectif Rejissuniversiteit (reinerianos). Research Group for Aquatic Toxicology. C. W. M. Bodar, I. van der Sluis, J. C. P. van Montfort, P. A. Voogt, and D. I. Zandee. Aquatic Toxicology AQTODG, Vol. 16, No. 1, p 33-40, January 1990. 1 fig, 2 tab, 17 ref.

Descriptors: *Acute toxicity, *Cadmium, *Daphnia, *Heavy metals, *Toxicology, *Water pollution effects, Metallothioneins, Neonate, Proteins, Re-

Adaptation of organisms to contaminated environ-Adaptation of organisms to contaminate environments is an area of current concern in ecotoxicology. Resistant organisms may have potential deleterious effects on the total environment through their potential for increased bioconcentration of the toxic agent. The potential of water-flea Daphthe toxic agent. The potential of water-liea Daph-nia magna to develop resistance to cadmium was investigated. Three successive generations of daph-nids were exposed to sublethal cadmium concen-trations, and thereafter the cadmium resistance was assessed in acute LC50 tests. Resistance to cadmium was acquired in a single generation. The ac-quired resistance was lost within 21 days if neoquired resistance was lost within 21 days in neo-nates of cadmium exposed daphnids were placed in cadmium-free test solution. Cadmium resistance thus proved not to be a genetic phenomenon. During a cadmium challenge absorption of cadmi-um was more rapid in cadmium pre-exposed animals than in control animals. The increased resistance might be attributed to the synthesis of metallothionein-like proteins. (Author's abstract)

EFFECTS OF THE CAROTENOID-INHIBIT-ING HERBICIDE, FLURIDONE, ON OSCILLA-TORIA AGARDHII GOMONT (CYANOBAC-

TERIA).
Agricultural Research Service, New Orleans, LA.
Southern Regional Research Center.
D. F. Millie, D. A. Greene, and P. B. Johnsen.
Aquatic Toxicology AQTODG, Vol. 16, No. 1, p
41-52, January 1990. 1 fig. 4 tab, 37 ref.

Descriptors: *Carotenoids, *Cyanophyta, *Fluridone, *Herbicides, *Plant physiology, *Water pollution effects, Light intensity, Photosynthesis, Plant growth, Plant pigments.

The effects of the pyridinone herbicide, fluridone, on the growth, pigment content and composition, and photosynthetic capability of Oscillatoria agardhii Gomont were investigated. Batch-culture flasks were inoculated with equal amounts of culture volume from an exponentially-growing culture and subjected to varying fluridone concentrations ranging from 0 to 100 microgram/L. Culture tions ranging from 0 to 100 microgram/L. Culture populations were allowed to grow without interruption for 96 hours after which populations were analyzed. Biomass, chlorophyll a and total carotenoid contents decreased with increasing concentrations. No change was observed in C-phycocyanin content. Within the lipophilic pigment fraction, decreases in the relative abundances of myxoxanthechyll, zewanthin beta-carotene, and on unidentifications. ophyll, zeaxanthin, beta-carotene, and an unidentified, minor carotenoid caused corresponding in-creases in the relative abundance of chlorophyll a. The light-limited slope, the maximum light-saturat-ed rate of photosynthetic oxygen evolution, and the irradiance value at onset of light saturation decreased with increasing fluridone concentration. Inhibition of growth and chlorophyll content was considered a secondary response attributable to the photo-oxidation of chlorophyll molecules. Inhibition of the photosynthetic efficiency and maximum were attributed to reduced carotenoid content. Increased knowledge concerning the effects of fluri-done on bloom-forming cyanobacteria, such as Os-cillatoria, may elucidate its possible algastatic utili-zation in aquaculture systems. (Author's abstract)

TOXICITY OF BIS(TRI-N-BUTYLTIN)OXIDE (TBTO) AND DI-N-BUTYLTINDICHLORIDE

(DBTC) IN THE SMALL FISH SPECIES ORY-ZIAS LATIPES (MEDAKA) AND POECILIA RETICULATA (GUPPY). Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Bilthoven (Netherlands). Lab. for Pathol-

ogy.
P. W. Chester, J. H. Canton, A. A. J. Van Iersel,
E. I. Krajnc, and H. A. M. G. Vaessen.
Aquatic Toxicology AQTODG, Vol. 16, No. 1, p
53-72, January 1990. 6 fig, 6 tab, 38 ref.

Descriptors: *Antifoulants, *Guppies, *Histology, *Medaka, *Organotin compounds, *Pesticides, *Toxicity, *Water pollution effects, Absorption spectrometry, Gas chromatography, Metabolism, Molluscicides, Tributyltin.

Toxicity studies were carried out on the Japanese medaka (Oryzias latipes) with bis(tri-n-butyltin)oxide (TBTO), a biocidal organotin used as an antifouling agent in paints and as a molluscicide in the tropics, and di-n-butyltindichloride (DBTC), with emphasis on histopathological effects. Freshly fertilized eggs were exposed for 1 and 3 months to a concentration range of 0.1-32 micrograms TBTO per liter in tank water. The range for DBTC was 320-3200 micrograms/L (I month only). The histopathological effects included vacuolation of hepatocytes, tubulonephrosis and glomerulopathy, vacuolation of the retinal pigment epithelium, keratitis, hyperplasia and inflammation glomerulopatny, vacuolation of the retinal pigment epithelium, keratitis, hyperplasia and inflammation of oral and skin epithelium, hyperplasia and swell-ing of the gas gland epithelium and thyroid activa-tion. No atrophy of the thymus was found. Except for the retinal and liver lesions, the changes ocfor the retinal and liver lessions, the canages oc-curred predominantly in the highest concentration with no essential differences in the lesions between 1 and 3 months, or between TBTO and DBTC exposure. Liver cell vacuolation was apparently exposure. Liver cell vacuolation was apparently caused by glycogen accumulation, as was confirmed in an additional experiment with guppies, a more expedient species. TBTO and DBTC have effects on the liver and gas gland, probably as a result of the impaired glycogen breakdown. Efects on superficial epithelial are attributed to the irritative properties of these compounds. In additional causes of the compounds of the compounds of the compounds. tion, these compounds were toxic to kidney and retina. Total tin and butyltin were determined by molecular absorption spectrometry, and gas chro-matography with flame photometry, respectively, in guppies exposed to TBTO and DBTC. Consid-erable amounts of TBT were measured in DBTCexposed fish, and chemical analysis indicated that DBTC contained TBT at a level that may account for the observed toxicity of DBTC. (Author's abstract) W90-07090

SHORT-TERM SUBLETHAL EFFECTS OF CADMIUM ON THE FILTER FEEDING CHIR-ONOMID LARVAE GLYPTOTENDIPES PAL-LENS (MEIGEN)(DIPTERA).

Amsterdam Univ. (Netherlands). F. Heinis, K. R. Timmermans, and W. R. Swain. Aquatic Toxicology AQTODG, Vol. 16, No. 1, p 73-90, January 1990. 7 fig. 1 tab, 32 ref.

*Bioaccumulation, *Cad *Heavy metals, *Insect behavior, *Midges, *Tox-icity, *Water pollution effects, Feeding, Larval growth stage

Macroinvertebrates are receiving increasing atten-tion as potential indicator organisms for monitor-ing the effects of water pollution. The effects of the trace metal cadmium on the behavior, biomass, bioaccumulation and survival of individual fourth bloaccumulation and survival or individual fourth instar larvae of the midge Giyptotendipes pallens (Diptera) were investigated in a series of laborato-ry experiments. Behavioral responses were quanti-fied by means of the impedance conversion techfied by means of the impedance conversion technique. A 96 hour exposure to cadmium gave rise to two different concentration-dependent response mechanisms. At concentrations of 0.1 to 1.0 mg/L of cadmium, slight deviations from the normal feeding pattern of unexposed larvae were observed. In this concentration range, larval uptake of cadmium increased slowly with no demonstrable effects on the survival of the larvae. However, development was retarded as indicated by the lower biomass values observed. The second mechanism became operative at concentrations between

approximately 2.5 and 10 mg/L cadmium. At a concentration of 2.5 mg/L, a large variability in behavioral responses to cadmium exposure was observed. Some exposed larvae exhibited only slight deviations from the normal activity patterns, while others developed totally aberrant behavioral patterns. All larvae that were exposed to cadmium concentrations of 5.0 and 10.0 mg/L demonstrated totally aberrant behaviors, characterized by long periods of inactivity. Further, food uptake ceased completely at these concentrations. Although the ultimate of survival of larvae exposed to the highest concentrations tested was strongly affected, the est concentrations tested was strongly affected, the exposure values were still substantially below the 144 hour LC50 level for cadmium. Behavioral effects resulting from a 96-hour exposure to cadmium were detectable at concentrations as low as 0.5 mg/L cadmium, a level that is 100 times lower than the 144 hour LC50 value. This fact indicates than the 144 hour DC30 value. This fact indicates that sublethal, ecologically relevant effects can be demonstrated in time spans normally utilized for acute toxicity testing. The use of the impedance conversion technique for the assessment of behavioral responses to contaminant exposures appears to hold particular relevance for the monitoring of freshwater pollution. (Author's abstract)

PATHOLOGICAL EUTROPHICATION: POINTS OF VIEW OF A BASIC ECOLOGIST, (L'EUTROFIZZAZIONE: REFLASSIONI D'UN ECOLOGO DI BASE).

Pavia Univ. (Italy)

C F Sacchi

Atti del Museo Civico di Storia Naturale di Trieste, Vol. 40, No. 1, p 13-23, December 15, 1987. 1 fig, 14 ref. English summary.

Descriptors: *Environmental effects, *Eutrophica-tion, *Limiting nutrients, *Nutrient concentrations, *Plant growth, *Water pollution effects, Biomass, Decomposition, Food chains, Marine pollution, Mesotrophy, Mineralization, Oligotrophy, Phosphorus compounds, Stagnation

Eutrophication of water bodies results from an overabundance of nutrients, such as phosphorus, overabundance of nutrients, such as phosphorus, calcium, sulfur, iron, silica, nitrogen, and potassium. The resulting overgrowth of aquatic vegetation can clog navigation channels, decrease overall species diversity, and block water circulation. It is also a normal condition, another successional stage in the evolution of the lake ecosystem. The biogeochemical cycle in the water and in the underlying sediments can create sources of nutrients from the chemical cycle in the water and in the underlying sediments can create sources of nutrients from the metabolism of denitrifying bacteria and biotic and abiotic mineralization of plant nutrients. Phospho-rus is usually the limiting nutrient in a conditioned aquatic system, since few sources of phosphorus exist. The eutrophication of a lake can be a chronic exist. The eutrophication of a lake can be a chronic process, taking thousands of years of slowly increasing vegetative growth, which impedes water circulation resulting in accumulation of catabolic products. Eutrophication can also be a acute result of the addition of large amounts of phosphorus, as in a sewage outfall or agrarian runoff, to an aquatic system. The species present in the ecosystem can be unable to metabolize the incoming nutrients, and may be replaced by ruderal species, such as cyanophytes, chlorophytes, and flagellates. These organisms outcompete the established vegetation, increase their population size rapidly, and change the lake ecosystem. Filter feeders and suspension feeders, such as bivalves, may have their feeding the lake ecosystem. Filter feeders and suspension feeders, such as bivalves, may have their feeding structures clogged by the planktonic algae, and, when the population begins to die, the sediment-dwelling bacteria may be unable to decompose the remains quickly enough to avoid anaerobic conditions. The immediate therapy for eutrophication is the removal of the excessive vegetative biomass, thereby increasing water circulation, and to add grazing organisms to further reduce the algal population. The solution must also include ways to ameliorate the symptoms, to allow the aquatic system to return to equilibrium. This solution must involve political backing on a local and regional involve political backing on a local and regional level, for the removal of phosphate detergents from the waterways, the elimination of illegal wastes, and the control of agrarian runoff. (Brunone-PTT)

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

CHRONIC EFFECTS OF LOW PH ON LENGTH AND WEIGHT OF ATLANTIC SALMON SALMO SALAR.

Maine Cooperative Fish and Wildlife Research Unit, Orono. C. M. Perry.

Environmental Biology of Fishes EBFID3, Vol. 27, No. 2, p 153-155, February 1990. 1 tab, 5 ref.

Descriptors: *Acid rain effects, *Acidic water, *Acidification, *Hydrogen ion concentration, *New England, *Salmon, *Water pollution effects, Fish physiology.

The acidification of lakes, rivers, and streams in eastern North America is a major concern to aquatic ecologists and fisheries managers. Acid stress seems to cause post-embryonic mortality, poor growth and deficient reproductive parameters such as egg production in Atlantic salmon. To test the effects of acid stress, measurements were made on Atlantic salmon from five sources in New England. Fish were reared at pH 7.0 and 5.2 from hatch to 199, 270 or 440 days. Length and weight were smaller in Atlantic salmon, Salmo salar, that were continuously exposed to low nH in weight were smaller in Atlantic salmon, Salmo salar, that were continuously exposed to low pH in the laboratory. Length and weight in neutral pH water varied among fish from the different sources. Fish from the Green Lake, Craig Brook, and Tunison sources were not significantly different in their lengths over time. Cortland and landlocked Atlantic balls of the significant tic salmon were not significantly different from one another but were significantly different from the other three sources. At pH 5.2, there were no significant differences in length between fish from any of the five sources. The Cortland salmon were significantly different from the other four sources in respect to their weight over time at neutral pH. At pH 5.2, there were no significant differences between any of the five sources. (Brunone-PTT) W90-07094

DAPHNIA AND TOXIC BLOOMS OF MICRO-CYSTIS AERUGINOSA IN BAUTZEN RESER-VOIR (GDR).

Technische Univ., Dresden (German D.R.). Sek-For primary bibliographic entry see Field 2H. W90-07096

EFFECT OF PH ON COPPER TOXICITY TO BLUE-GREEN ALGAE.

Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.

rimary bibliographic entry see Field 4A.

PHOSPHORUS LOAD-CONCENTRATION RE-LATIONSHIP IN LAKE DAL, A HIGH ALTI-TUDE MARL LAKE IN THE KASHMIR HIMA-

LAYAS. Kashmir Univ., Srinagar (India). Dept. of Botany. For primary bibliographic entry see Field 2H. W90-07100

CENOLOGICAL RELATIONS OF MUD VEGE-TATION OF A HYPERTROPHIC LAKE IN TIS-ZAALPAR BASIN.

Jozsef Attila Univ., Szeged (Hungary). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W90-07110

EUTROPHICATION OF THE DEAD THEISS INDICATED BY OLIGOCHEATE.

Novi Sad Univ. (Yugoslavia). Inst. of Biology. N. Djukic. Tiscia TSCAB8, Vol. 23, p 61-64, 1988. 2 fig, 5 ref.

Descriptors: *Eutrophication, *Oligochaetes, *Species composition, *Stagnant water, *Tisza River, *Water pollution effects, Agricultural runoff, Biomass, Nonpoint pollution sources, Population density, Population dynamics.

A good estimation of the degree of eutrophication present in stagnant waters can be made analyzing the presence of oligochaete communities. The

study of oligochaete communities in the dead Tisza River (Theiss) in the years 1983-1987 shows very rapid eutrophication in this stagnant tributary (the former riverbed of the Tisza) The area studied is situated in a region of arable land with an intensive situated in a region of arable land with an intensive agricultural activity which, due to the inflow of nutritive elements, has a great influence on the increase in primary and secondary production. On the basis of average percentage of oligochaetes present, the dominant organisms are eutrophic species, such as Limnodrilus sp., Limnodrilus hoff-meisteri, Limnodrilus claparedeanus, Limnodrilus udekemianus, and Potamothrix hammoniensis. The number of individuals and their biomass show rapid population growth, another characteristic of eutrophic waters. (Brunone-PTT)

MACROZOOBENTHOS IN THE RIVER TISZA

AND ITS INFLUENTS.
Fisheries Research Inst., Szarvas (Hungary).
A. Szito, and M. Botos.
Tiscia TSCAB8, Vol. 23, p 65-75, 1989. 3 fig, 3 tab,

Descriptors: *Benthic fauna, *Chironomids, *Oligochaetes, *Plankton, *Population density, *Tisza River, *Water pollution effects, *Water pollution sources, Domestic wastes, Hungary, Industrial wastewater, Species composition, Wastewater pollution

Samples were collected from various sediments of the Tisza River from Tokaj to Szeged in Hungary between September 16-24, 1985. The oligochaetes between September 16-24, 1985. The oligochaetes and the chironomids were the dominant species of the macrozoobenthos, and the population density of oligochaetes was higher than that of chironomid larvae. Of the fourteen oligochaete species, Tubifex nowaensis was found in the channel line of the Tisa, and Limnodrilus species and the Branchiura sowerbyi in the river bank zone. Of the 21 chironomid species, Chironomus fluviatilis, Harnischia et chironomid species were found in the Hungarian fauna. The numbers of species in the oligochaete communities have decreased in recent vears, but chironomid communities have become oligochaete communities have decreased in recent years, but chironomid communities have become years, but chironomic communities have become richer, mainly because of the occurrence of limnophyl species. In the influents loaded with sewage (Sajo, Zagyva), only the oligochaete species remain vital. The influence of industrial and communal sewage results in a decrease of the invertebrate fauna of the Tisa River. (Author's abstract) W90-07116

CHANGES IN THE QUALITY OF WATER IN LASKO STREAM AND THE STORAGE LAKE BUILT ON IT AT EGERSZALOK. Heves County Service of Public Health and Epidemiology, Eger (Hungary). B. Estok, and E. Milinki. Tiscia TSCAB8, Vol. 24, p 11-22, 1989. 5 fig, 2 tab,

Descriptors: *Dam effects, *Phytoplankton, *Species composition, *Water pollution effects, *Water quality, *Zooplankton, Cladocera, Cyanophyta, Eutrophication, Hungary, Rotifers, Seasonal variation, Species diversity, Storage reservoirs.

Egerszalok storage lake was built by damming Lasko stream in 1981 for flood control and irrigation, and is of considerable importance for fishing as well. Lasko stream was investigated in the period 1984-1987 at Egerszalok and Üjlorincfalva; at the same time a detailed hydrobiological assessment was performed of Egerszolak storage lake. The water of Egerszolak storage lake is eutrophic. The compositional and seasonal changes of the phytoplankton and zooplankton were followed while the lake became stagnant. The dominant plankton species belonged to group of organisms characteristic stagnant eutrophic waters. The species richness in the storage lake increased towards summer and decreased towards winter. From the cies riciness in the storage take increased towards summer and decreased towards winter. From the beginning of summer through early autumn, bluegreen algae were the dominant organisms. Two characteristic species diversity minima exist, one in winter and the other in summer. Copepoda prevail in the zooplankton composition the whole year

round, followed by rotifers and cladocerans. The effects of the storage lake can be detected at Egerszalok. At Ujlorincfalva the unfavorable factors are less noticeable. This is important since Lasko stream is a feed water of Kiskore storage lake. (Author's abstract) (Author's al W90-07118

INFLUENCE OF THE WASTE-WATER OF SZOLNOK ON THE WATER QUALITY OF THE TISZA RIVER.

Central Tisza Region Environmental and Water Conservancy Directorate, Szolnok (Hungary). For primary bibliographic entry see Field 5B. W90-07119

CHANGES IN THE FISH POPULATION OF THE INTERMITTENTLY CLOSED TISZA-DEAD-ARM.

Miksa Deri Machine Industrial Secondary School Szeged, Hungary. A. Farkas.

Tiscia TSCAB8, Vol. 24, p 69-77, 1989. 1 fig, 4 tab,

Descriptors: *Fish populations, *Ice cover, *Species composition, *Tisza River, *Water pollution effects, Fishing, Flooding, Hungary, Oxygen depletion, Population dynamics, Seasonal variation,

The fish population of the Tisza River and the dead Tisza at Lakitelek, in Hungary has been studied and its seasonal changes followed since 1982. The effects of both ecological and anthropogenic The effects of both ecological and anthropogenic factors on the fish stock were examined. Annual changes in the fish species of the dead-arm have been followed. A species list was compiled, indicating species occurrence and disappearance from the dead arm. The number of individuals and the species composition of the fish population in the dead arm is determined by the following factors:

(1) periodic floods; (2) oxygen depletion in the summer; and (3) fish introduction into the dead arm legal oxers of the deed arm in writer also summer; and (3) fish introduction into the dead arm. Icing over of the dead arm in winter also cause fish destruction. The fish population in the River is affected by the following factors: (1) seasonal changes such as migration and spawning; (2) occasional pollution; (3) spawning and withdrawal of the hatched progeny from the flood plain; and (4) fishing intensity. A decrease in several fish species is probably the result of increased wastewater pollution from the town of Szolnok. (Brunone-PTT) W90-07121

ALUMINUM TOXICITY IN FORESTS EX-POSED TO ACIDIC DEPOSITION: THE ALBIOS RESULTS. Maine Univ., Orono. Dept. of Botany. For primary bibliographic entry see Field 5B. W90-07125

RESPONSE OF FRESHWATER ALGA SCENEDESMUS TO TRIAZINE HERBICIDES. National Research Centre, Cairo (Egypt). Water Pollution Control Lab.

M. A. El-Dib, S. A. Shehata, and H. F. Abou Waly.

Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 3/4, p 307-316, November 1989. 2 fig, 6 tab, 21

Descriptors: *Chlorophyta, *Herbicides, *Triazines, *Water pollution effects, Agricultural chemicals, Bioassay, Chlorophyll, Culturing techniques, Hydrogen ion concentration, Laboratory methods, Plant morphology, Plant physiology, Statistical analysis, Structure-activity relationships, Water pollution sources.

The effect of three triazine herbicides widely used The effect of inner triazine neroticises wicely used for the control of herbs and aquatic weeds, namely Gardoprim, Gesapax, and Igran on the freshwater alga, Scenedesmus sp., was studied. These herbicides may reach surface waters by leaching from treated lands or by discharge by agriculture drains. Growth rate, chlorophyll (a) content, and ratio of

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chlorophylls (a/b) tend to decrease as the concentration of herbicides in the bioassay media was increased. The inhibitory effect of the herbicides was in the following order: Igran > Gesapax > Gardoprim. Results reflect the relation between chemical structure and toxicity even within a chemically related group of herbicides. Uptake of the studied compounds by Scenedesmus algal cells decreased as the concentration of herbicides in the was increased. The hydrogen ion concentramedia was increased. In a nyurogen ion concentra-tion of the bioassay media showed gradual increase as algal growth proceeded, whereas in media con-taining inhibitory levels of the triazines, the hydro-gen ion concentration was unaffected. Microscopi-cal examinations of Scenedesmus in all tested cultures showed marked morphological changes. In the case of inhibitory concentrations, the unicellu-lar forms increased in numbers compared to Scen-edesmus in the normal four-cell state. Statistical analysis revealed that a significant relation existed between herbicide concentrations and chlorophyll content. (Author's abstract) W90-07128

IMPACT OF ARTIFICIAL AMMONIUM-EN-RICHED RAINWATER ON SOILS AND YOUNG CONIFEROUS TREES IN A GREEN-HOUSE, PART 1-EFFECTS ON THE SOILS. HOUSE. PART 1-EFFECTS ON THE SOILS, Katholieke Univ. Nijmegen (Netherlands). Dept. of Aquatic Ecology and Biogeology. H. F. G. Van Dijk, R. C. M. Creemers, J. P. L. W. M. Rijniers, and J. G. M. Roelofs. Environmental Pollution ENPOEK, Vol. 62, No. 4, p 317-336, 1989. 1 fig, 11 tab, 26 ref.

Descriptors: *Acid rain effects, *Acidification, *Coniferous forests, *Fertilizers, *Forests, *Nitrogen, *The Netherlands, Aluminum, Ammonium compounds, Cations, Manganese, Plant growth,

Air pollutants are generally accepted to be a major cause of forest decline in Europe and North America. Toxic and acidifying substances like ozone, sulfur dioxide and nitrogen oxides are often mentioned in this context and their effects on plants are toned in this context and therefree is no plants are being studied intensively. However, during the last few years several investigators have pointed out that overloading of the forest stands with nitrogen may also play an important role. A pot experiment was used to investigate whether ammonium sulfate, when applied in amounts comparable to those deposited in the Dutch forests, is detrimental to trees. Young coniferous trees were planted in pots in a greenhouseand treated with artificial ammonium-enriched rainwater. The deposition of ammoni-um resulted in a strong acidification of the soil solution, leaching of base cations and an increased solubility of aluminum, manganese and an increased solubility of aluminum, manganese and zinc. Ammonium accumulated in the soil solution, causing severe imbalances between plant nutrients. (Mertz-PTT W90-07138

IMPACT OF CATTLE ON TWO ISOLATED FISH POPULATIONS IN PAHRANAGAT VALLEY, NEVADA. Nevada Univ., Las Vegas. Dept. of Biological

For primary bibliographic entry see Field 4C.

TOXICITY AND ISOLATION OF THE CYANO-BACTERIUM NODULARIA SPUMIGENA FROM THE SOUTHERN BALTIC SEA IN 1986. SPUMIGENA Helsinki Univ. (Finland). Dept. of Microbiology. K. Sivonen, K. Kononen, A. L. Esala, and S. I. Niemela.

Hydrobiologia HYDRB8, Vol. 185, No. 1, p 3-8, November 1989. 2 fig, 2 tab, 19 ref.

Descriptors: *Algal blooms, *Algal toxins, *Baltic Sea, *Cyanophyta, *Domestic animals, *Eutrophication, *Toxicity, Acute toxicity, Bioassay, Germany, Nodularia, Sweden, The Netherlands,

Mortality of domestic animals in connection with Nodularia-dominated blooms have been reported on the Swedish, Danish, and German coasts in the

southern Baltic Seas as well as on coastal areas of the northern Baltic Sea. Toxicity has been attribthe northern Baltic Sea. Toxicity has been attrib-uted to either the fact that the poisoned animals were in contact with the algal accumulates and in a few cases the toxicity of the algal bloom material was shown. Three water bloom samples were col-lected in August 1986 from the southern Baltic Sea. Acute toxicity of the samples was determined Sea. Acute toxicity of the samples was determined by mouse bioassay and the toxins were further studied by high performance liquid chromatography. The bloom samples contained equal amounts of cyanobacteria Nodularia spumigena and Aphanizomenon flos-aquae and were hepatotoxic. Two izomenon flos-aquae and were hepatotoxic. Two hepatotoxic Nodularia spumigena strains were isolated from the samples. The isolates produced a toxic peak indistinguishable from the bloom material in the high performance liquid chromatography analysis. The toxicity of the fractions was verified by mouse bioassay. Thus, the toxicity of the bloom samples was in all likelihood caused by Nodularia spumigena. (Mertz-PTT) W90-07144

TOXICITY OF CADMIUM TO DIFFERENT LARVAL INSTARS OF THE TRICHOPTERAN LARAVE AGAPETUS FUSCIPES CURTIS AND THE IMPORTANCE OF LIFE CYCLE INFOR MATION TO THE DESIGN OF TOXICITY

University of Wales Inst. of Science and Technoloomversity of wates inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
C. P. McCahon, A. J. Whiles, and D. Pascoe.
Hydrobiologia HYDRB8, Vol. 185, No. 2, p 153162, November 1989. 1 fig, 3 tab, 46 ref.

Descriptors: *Bioassay, *Caddisflies, *Cadmium, *Toxicity, *Water pollution effects, Agapetus, Life cycles, Sublethal effects, Tricoptera, Water pollu-

To obtain a realistic assessment of overall pollutant impact and also to expand the toxicity data base it is important that species other than those traditionally considered sensitive be employed in toxicity ally considered sensitive be employed in toxicity studies. The Trichoptera, being relatively tolerant have been neglected when selecting test species. They are a key order in the trophic structure of streams, the group displaying a great ecological diversity, with species from a wide range of habitats and representatives from all major feeding strategies. The acute toxicity of cadmium to three larval instars (1st, 3rd, and 4th) of the cased trichopteran Agapetus fuscipes Curtis was determined for animals both in the cased and uncased state. First instar larvae were significantly more state. First instar larvae were significantly more sensitive than 3rd or 4th instars and for all ages cased animals were more resistant than uncased. Sub-lethal toxicity was demonstrated by a reduc-tion in case building activity and aggregation re-sponse. It is important to consider life cycle infor-mation when designing toxicity tests and to incorporate sub-lethal responses into a study. (Mertz-W90-07155

EFFECT OF HEATED WATERS OF THE TRI-POL'E THERMAL POWER STATION ON THE SANITARY AND HYDROBIOLOGICAL CHAR-ACTERISTICS OF THE KANEV RESERVOIR.
V. I. Shcherbak, N. V. Omel'chenko, and G. A.

Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 340-344, 1990. 3 fig, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 31-34, June, 1989.

Descriptors: *Aquatic productivity, *Heated water, *Phytoplankton, *Soviet Union, *Temperature effects, *Thermal pollution, *Thermal powerplants, Kaney Reservoir, Organic matter, Primary production. Thermal power

The effect of the heated discharge waters of the Tripol'e thermal power station (USSR) on the structural (species composition, numbers, biomass) and functional (magnitude of primary production, destruction, and their ratio) characteristics of phytoplankton of the Kanev reservoir were investigat-ed. Parameters were evaluated during a steady hydrobiological regime and while bringing the sta-tion to the design capacity. The ratio of primary

production to destruction of organic matter showed the direction of the production-destruction processes and characterized the process of selfpurification. The values of primary production:destruction of organic matter varied widely, from 0.4 to 6.3. A comparison of the average values showed that in heated water the ratio was somewhat less (1.1-1.9), compared to the ratio in natural water not subjected to heating (1.9-The purification. values primary ratio in natural water not subjected to heating (1.92.6). This indicates that the process of self-purification occurred more intensely in the stretch of the
reservoir subjected to the influence of the discharge waters of the Tripol's thermal power station. It is concluded that the thermal power plant
did not have a substantial negative effect on the
phytoplankton of the Kanev reservoir. An increase
of the flow and rate of destruction of organic
matter related to minimum heating of the water as matter related to minimum heating of the water as well as to the more uniform vertical distribution of production-destruction processes and oxygen con-tent in the water flow, can be considered a positive factor affecting the ecosystem of the Kanev reser-voir. (Mertz-PTT) W90-07170

CATASTROPHIC BIFURCATIONS IN A SECOND-ORDER DYNAMICAL SYSTEM WITH APPLICATION TO ACID RAIN AND FOREST COLLAPSE.

Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.

S. Muratori, and S. Rinaldi.

Applied Mathematical Modelling AMMODL,
Vol. 13, No. 12, p 674-681, December 1989. 6 fig, 16 ref.

Descriptors: *Acid rain effects, *Ecosystems, *Forests, *Insects, *Mathematical models, Catastrophes, Infestations.

A second-order nonlinear dynamical system mod-elling the interactions of trees and damaging in-sects in a forest is used to analyze the influence of acidic deposition, an increase of which can cause sudden insect infestations and the collapse of the sudden insect infestations and the collapse of the forest ecosystem. The analysis is carried out by finding the bifurcations of the system and by proving that under suitable conditions, such bifurcations can be catastrophic. In particular, the model explains the case in which the damaging insects are present only at an endemic level as well as the case in which the forest is periodically infested by insects. In the case in which predisposition of forest trees to insect infestation is enhanced by acidic deposition, it is shown that the point at which the first impacts on tree biomass are detectable can be first impacts on tree biomass are detectable can be easily quantified by a simple formula which says that the forests that should be affected first are those that have a large carrying capacity of the trees, a large maximum birth rate and a low death rate of the insects, and a low pressure of the predators on the insects. The analysis can also distinguish between smooth impacts (decline of tree biomass) and dramatic impacts (collapse of the forest). (Sand-PTT)
W90-07185

EFFECTS OF COMPLEX WASTE MIXTURES ON HEPATIC MONOOXYGENASE ACTIVI-TIES IN BROWN BULLHEADS (ICTALURUS NEBULOSUS).

Duke Univ., Durham, NC. School of Forestry and Environmental Studies.

E. P. Gallagher, and R. T. Di Giulio.

Environmental Pollution ENPOEK, Vol. 62, No. 2/3, p 113-128, 1989. 3 tab, 45 ref.

Descriptors: *Bioindicators, *Bullhead, *Enzymes, *Water pollution effects, Liver, Organic com-pounds, Stream pollution, Trace metals.

Hepatic mixed function oxidase (MFO) components (cytochrome P450, cytochrome b5, and ethoxyresorufin O-deethylase, EROD) were measured in brown bullheads (Ictalurus nebulosus) inhabiting a creek receiving a complex mixture of organics and trace metals. The activities of these enzymes were also measured in bullheads from an uncontaminated reference site to assess the relative shifty minated reference site to assess the relative ability of MFO parameters to serve as a biomarker of

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aquatic pollution. Bullheads analyzed from the pol-luted site had lower hepatic microsomal P-450 (p<0.01) concentrations and similar EROD activi-ties per marteis and similar EROD activi-(p-0.01) concentrations and similar EROD activities per mg protein compared to bullheads from the reference site. However, analysis of enzyme turnover ratios revealed greater EROD activity per mg cytochrome P-450 (p-0.05) in the fish from the polluted site. No differences in cytochrome b5 activities were observed between the two groups. Compared to the reference site, bullheads collected from the polluted creek had an increased occurrence of lip and lower jaw lesions and liver damage, including elevated liver/body weight ratios. Accordingly, the monooxygenase activities measured in this study were not reliable indicators of chemical pollution or contaminant stress in bullheads in the polluted creek. Further research is needed concerning contaminant interactions, particulated. needed concerning contaminant interactions, par-ticularly among organic pollutants and metals and their effects on monooxygenase activities. (Author's abstract)

LONG-TERM CHANGE IN THE SUITABILITY OF WELSH STREAMS FOR DIPPERS CINCLUS CINCLUS AS A RESULT OF ACIDIFICATION AND RECOVERY: A MODELLING STUDY.

STUDY. University Coll., Cardiff (Wales). School of Pure and Applied Biology. S. J. Ormerod, and S. J. Tyler. Environmental Pollution ENPOEK, Vol. 62, No. 2/3, p 171-182, 1989. 3 fig, 1 tab, 27 ref.

Descriptors: *Acid rain effects, *Acid streams, *Acidic water, *Coniferous forests, *Model studies, *Water, Water birds, *Water chemistry, *Water unimnum, Hydrogen ion concentration, Simulation, Sulfates.

Using a recognized and widely used hydrochemical model, MAGIC, long-term changes in acidity were simulated at 104 sites in the acid sensitive region of upland Wales. Conditions were modeled were simulated at 104 sites in the acid sensitive region of upland Wales. Conditions were modeled in the future (2010) under different reductions in sulfate deposition from 0-90% of 1984 values. Chemical output from the model was used to simulate change in the chemical suitability of streams for a species of river bird, the dipper Cinclus cinclus, known to be affected by acidification. General patterns of chemical change for individual streams in MAGIC depend on catchment sensitivity to acidification, but the typical response in sensitive cases was a progressive decrease in pH and increase in Al concentration from the early 20th century onwards. These changes were most pronounced under simulated forest, particularly for Al, where they persisted even with a 50% reduction in sulfate deposition from 1984 onwards. On a regional scale, the forecasts indicated that reductions in sulfate deposition of at least 50% were required to arrest further acidification, while continued deposition at 1984 levels led to an increase in the percentage of sites which were highly acidic. The two models of suitability for dippers gave results which were qualitatively identical and quantitatively similar. In 1984, pH and Al concentrations indicated that 37-44% of sites in the Welsh acid-sensitive region were chemically suitable for themselved. trations indicated that 37-44% of sites in the Weish acid-sensitive region were chemically suitable for dippers. These values are likely to indicate the maximum possible occurrence of birds, however, since only half of the sites where occurrence was predicted in 1984 actually contained dippers. According to the future simulations, a reduction in predicted in 1984 actually contained dippers. Ac-cording to the future simulations, a reduction in sulfate deposition over 50% of 1984 values was required to increase the number of sites where pH and Al concentrations were suitable for dippers. Deposition reductions which were less than 50 led to continued loss of suitable sites, whereas reductions of 90% brought pH and Al concentrations at nearly all sites to a level suitable for dippers to occur. (Sand-PTT) W90-07194

ACID AND ALUMINUM EFFECTS ON FRESH-WATER ZOOPLANKTON: AN IN SITU MESO-COSM STUDY.

Kent State Univ., OH. Dept. of Biological Sci-

K. E. Havens, and R. T. Heath. Environmental Pollution ENPOEK, Vol. 62, No.

Descriptors: *Acid rain effects, *Aluminum, *Lake acidification, *Mesocosms, *Water pollution effects, *Zooplankton, Acid lakes, Acidic water, Crustaceans, East Twin Lake, Ohio, Toxicity, Wa-

2/3, p 195-211, 1989. 7 fig, 1 tab, 19 ref.

An in situ mesocosm experiment was performed to evaluate the role of aluminum toxicity in determining zooplankton community responses to lake acidification. Large plastic enclosures were suspended in East Twin Lake, Ohio, and duplicates were either untreated controls (pH 8.8), acidified to pH 4.5 over a 23 day period, or acidified and also spiked with incremental additions of Al, to also spiked with incremental additions of Al, to produce a final inorganic monomeric Al level of 180 microgram/1 at pH 4.5. Zooplankton abundance and species richness declined in both acid treatments, relative to the control, as numerous acid-sensitive species were eliminated. All of the acid-sensitive species were also Al-sensitive, declining in abundance more rapidly in the acid plus Al treatment than in the acid-alone treatment. Only two small cladocerans (Bosmina longinostris and Chydorus sphaerican) were acid telerare. Both and Chydorus sphaericus) were acid tolerant. Both were also tolerant of elevated Al levels. (Author's

ASSESSMENT OF NUTRIENT EFFECTS AND NUTRIENT LIMITATION IN LAKE OKEE-

Florida Univ., Gainesville. Dept. of Fisheries and

Aquaculture. C. L. Schelske.

Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1119-1130, December 1989. 10 fig, 1 tab, 36

Descriptors: *Lake Okeechobee, *Limiting nutrients, *Limnology, *Model studies, *Nutrients, *Phytoplankton, *Trophic level, Algae, Aquatic plants, Chlorophyll, Eutrophication, Florida, Lakes, Phosphorus, Nitrogen, Seasonal variation.

Lake Okeechobee, the third largest lake in the United States, is a shallow, mixing basin with annual total phosphorus concentrations ranging from 50-100 microgram P/L. Data, mainly from mumpublished agency reports, are analyzed to determine if nutrients limit phytoplankton, to describe spatial and temporal variability in trophic state parameters, and to evaluate conclusions obtained from empirical trophic state models. Algal bioassay experiments that have been used to assess nutrient limitation have produced equivocal results. How-ever, seasonal minima in orthophosphorus and in-organic nitrogen indicate that both may be limiting organic nitrogen indicate that both may be limiting seasonally. Strong, but reverse north-south gradients and large seasonal changes in phosphorus and nitrogen concentrations, show that empirical models based on annual phosphorus loadings or concentrations are not adequate to predict chlorophyll concentrations or other trophic state variables. Spatially-segmented, multi-class phytoplankton-nutrient models of seasonal phytoplankton responses that are coupled with hydrodynamic models may provide predictability in assessing effects of changing nutrient loads on phytoplankton composition and standing crop. Successful modeling efforts of responses to nutrients also must deal with resuspended and benthic algae, periphyton, and emergent and submergent aquatic plants that must play important trophic roles in some of the lake basin. (Author's abstract)

INCIDENCE OF FIN EROSION AND ANOMA-LOUS FISHES IN A POLLUTED STREAM AND A NEARBY CLEAN STREAM. Ohio State Univ., Columbus. Environmental Biol-

ony Program.

R. J. Reash, and T. M. Berra.

Water, Air and Soil Pollution WAPLAC, Vol. 47, No. 1-2, p 47-63, September 1989. 5 fig. 2 tab, 39 ref. U.S. Army Corps of Engineers contract DAC-W69-83-M-0698.

Descriptors: *Animal pathology, *Fish diseases, *Stream pollution, *Water pollution effects, Bioin-

dicators, Clear Fork stream, Ohio, Rocky Fork stream, Water temperature.

This study documents the incidence of fin erosion and deformed (anomalous) fishes in two adjacent midwestern streams, north-central Ohio. Clear midwestern streams, north-central orio. Clear Fork stream flows through agricultural and forest-ed areas, whereas Rocky Fork stream flows through industrialized Mansfield, Ohio, where it receives industrial and municipal effluents. Four receives industrial and municipal effluents. Four sites on each stream were sampled monthly for fishes during July 1982 through August 1983. Incidence of fin erosion was significantly greater (P<0.01) at polluted sites compared to unpolluted sites (P>0.05). Incidence of fin erosion in fish from polluted sites was inversely correlated with water temperature (P<0.002). Severity of fin erosion was greater in fishes collected from polluted sites. Inspection of fin erosion was greater in fishes collected from polluted sites. Inspection of fin erosion was greater in fishes collected from polluted sites. Inspection of fin erosion was greater in fishes collected from polluted sites. Inspection of fin erosion was greater in fishes collected from polluted sites. Inspection of fin erosion was greater in fishes collected from polluted sites. In the location of fin erosion was greater in fishes collected from polluted sites. In the location of fin erosion was greater in fishes collected from polluted sites. terspecific differences in the location of fin erosion terspectric currences in the location of in erosion were observed. Creek chubs, white suckers, and stonerollers had the highest incidence of external deformities. Statistical differences in the incidence of deformed fish between combined polluted sites of deformed fish between combined polluted sites and combined unpolluted sites were not evident (P>0.05). Nevertheless, total incidence of deformed fishes at polluted sites (0.53%) seemed to elevated compared to total incidence of deformed fishes at unpolluted sites (0.28%). Comparative studies between fish from streams suspected of being polluted and fish from nearby unpolluted, reference streams should be used to define effects of chronic pollution. (Author's abstract) W90-07218

ZIRCONIUM TOXICITY ASSESSMENT USING BACTERIA, ALGAE AND FISH ASSAYS.

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).

P. Couture, C. Blaise, D. Cluis, and C. Bastien.

Water, Air and Soil Pollution WAPLAC, Vol. 47, No. 1-2, p 87-100, September 1989. 3 fig, 3 tab, 41

Descriptors: *Bioassay, *Toxicity, *Water pollution effects, *Zirconium, Algae, Bacteria, Fish,

Bioassays using bacteria, microscopic algae, and fish confirms the hypothesis that Zr has low toxicity. Toxic effects revealed with the Microtox test (Photobacterium phosphorem bioluminescent test) (Photobacterium phosphoreun bioluminescent test) may be attributed to pH rather than specifically to Zr (5-min EC50 >4.3 mg/L). Fish assays (Salmo gairdneri) also confirmed the low toxicity of Zr (96-hr LC50 >20 mg/L). Mutagenicity (Fluctuation test using Salmonella typhimurium) and genotoxicty (S.O.S. Chromotest using Escherichia coil) assays failed to show any DNA-related effects linked to Zr. Only the algal assays (ATP energy stress test using Selenastrum capricornutum) demonstrated genuine toxicity at Zr concentrations between 1.3 and 2.5 mg/L. (Author's abstract) W90-07221 W90-07221

CLOUD CHEMISTRY MEASUREMENTS AND ESTIMATES OF ACIDIC DEPOSITION ON AN ABOVE CLOUDBASE CONIFEROUS FOREST. North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.

V. K. Saxena, and N.-H. Lin.

Atmospheric Environment ATENBP, Vol. 24A, No. 2, p 329-352, 1990. 8 fig, 11 tab, 58 ref. EPA Agreement No. ESRL-CA-01.

Descriptors: *Acid rain, *Cloud chemistry, *Co-niferous forests, Dry deposition, Hydrogen ion concentration, Nitrogen, Sulfur, Wet deposition.

The wet, dry and cloud water deposition of acidic The wet, dry and cloud water deposition of acidic substances on the forest canopy are considered as major mechanisms for pollutant-induced forest deline at high elevations. Direct cloud capture plays a predominant role of intercepting acidic substances in above-cloudbase forests. We conducted a field study at Mt. Mitchell, North Carolina (2038) m above mean sea level)—the highest peak in the eastern U.S.—during May-September 1986 and 1987 in order to analyze the chemistry of clouds in

Group 5C-Effects Of Pollution

which the red spruce and Fraser fir stands stay immersed. It was found that Mt. Mitchell was exposed to cloud episodes 71% of summer days, the cloud immersion time being 28% for 1986 (a record drought summer in southeastern U.S.) and 41% for 1987. Sulfate, nitrate, ammonium and hydrogen ions were found to be the major constitu-ents of the cloud water, which was collected atop a 16.5 m tall meteorological tower situated among 6-7 m tall Fraser fir trees. The initiation of precipi-tation in clouds invariably diluted the cloud water acidity. The cloud water pH during short episodes (8 h duration or less), which resulted from the orographic lifting mechanisms, was substantially lower than that during long episodes, which were associated with meso-scale and synoptic-scale disturbances. Sulfate accounted for 65% acidity in cloud water, in the average, and contributed 2-3 times more than the nitrate. Inferential micrometeorological models were used to determine depo-sition of sulfate and nitrate on the forest canopy sition of sulfate and nitrate on the forest canopy and the hydrological input due to direct cloud capture mechanism. The cloud water deposition ranged between 32 and 55 cm/yr in contrast to the bulk precipitation which was about 130 cm/yr as measured by an on-site National Atmospheric Deposition Program collector. For S compounds, wet, dry and cloud water deposition accounted for 19%, 11% and 70%, respectively for 1986, and 16%, 8% and 76%, respectively for 1987. For nitrogen compounds, dry deposition contributed 35% and 23% for 1986 and 1987, respectively, whereas, cloud water deposition contributed 50% and 65% for 1986 and 1987, respectively. Our estimates are compared with the reported literature values for the other sites. (Author's abstract) W90-07229

IMPACT OF A MASSIVE CRUDE OIL SPILL ON THE INVERTEBRATE FAUNA OF A MIS-

ON THE INVENTED HATE FAUNA OF A MISSOURI OZARK STREAM.
Missouri Dept. of Conservation, Columbia.
R. L. Crunkilton, and R. M. Duchrow.
Environmental Pollution ENPOEK, Vol. 63, No. 1, p 13-31, 1990. 3 fig, 5 tab, 41 ref.

Descriptors: *Asher Creek, *Macroinvertebrates, *Missouri, *Oil pollution, *Oil spills, *Water pollution effects, Benthic environment, Caddisflies, Midges, Mayflies, Species diversity, Worms.

The benthic macroinvertebrate fauna of Asher Creek, a 4th order stream with a base flow of 0.03 cu m/s, was monitored on 11 occasions for 532 days following a 1.5 million liter domestic crude oil spill. Aquatic insects, crustaceans, segmented worms, roundworms, flatworms, snails, freshwater mussels and other benthic organisms in the oil impacted area were reduced to less than 0.1% of impacted area were reduced to less than 0.1% of expected numbers at the first sampling period 25 days after the spill. Species diversity indices and the number of mayfly and stonefly taxa were less than the minimum values established for unpolluted Missouri streams for 11 months. The initial posterial companyity was dominated by Chiesa-spill companyity was domina ed Missouri streams for 11 months. The initial post-spill community was dominated by Chironomidae (midges), Simuliidae (blackflies) and Oligochaeta (segmented worms). Some species of Plecoptera (stoneflies), Ephemeroptera (mayflies) and Tri-choptera (caddisflies) were absent from the fauna for as long as 9 months. The functional feeding groups of scrapers, filterers, gatherers, and preda-tors initially decreased in relative abundance. Predators later increased in response to a rapidly ex-panding prey base. Shredders did not change in panding prey base. Shredders did not change in relative abundance throughout the recovery period. Oil was visually present in the stream riffle substrate for 453 days following the spill. Dissolved oxygen, pH and conductivity were not affected. The visible appearance of oil in the stream substrate was a simple predictor of the status of the benthic investment community. Areas protected benthic invertebrate community. Areas protected with surface skimming siphon dams were less se-verely impacted and recovered more rapidly than areas where the stream substrate was inundated with oil. The most apparent factors controlling the recovery were the total volume of water passing through the contaminated area and the occurrence of scouring floods. (Author's abstract) W90-07239

IMPACT OF ARTIFICIAL, AMMONIUM-EN-RICHED RAINWATER ON SOILS AND

YOUNG CONIFEROUS TREES IN A GREEN-HOUSE, PART II-EFFECTS ON THE TREES, Katholieke Univ. Nijmegen (Netherlands). Lab. of

Aquatic Ecology. H. F. van Dijk, M. H. de Louw, J. G. Roelofs, and J. J. Verburgh.

3. J. verourgn. Environmental Pollution ENPOEK, Vol. 63, No. 1, p 41-59, 1990. 12 tab, 35 ref. Dutch Ministry of Housing, Physical Planning and Environment Project 621.046-01.

Descriptors: *Acid rain, *Ammonium, *Conifers, *Nitrogen, *Rain, *Water pollution effects, Biological studies, Biomass, Calcium, Magnesium, Nutri-

To obtain an insight into the effects of a high ammonium deposition on trees, young, coniferous trees were planted in pots in a greenhouse and treated with artificial ammonium-enriched rainwater. Application of 480 kg ammonium-N/ha/yr resulted in an increase of the shoot/root ratio. The biomass of fine roots strongly declined, as did the numbers of mycorrhizae. The fructification of the numbers of mycorrhizae. The fructification of the mycorrhizal fungi was totally inhibited. The nitrogen content of the needles was enhanced, but the levels of potassium, magnesium and calcium decreased sharply. The phosphorus content remained almost unaffected. Much of the nitrogen was stored as arginine. The levels of leaf pigments also increased. Within one year of treatment many of the trees died. The trees that were treated with 48 kg ammonium-N/ha/yr did not show any signs of deterioration. (Author's abstract)

INHIBITION OF FERTILIZATION IN THE SEA URCHIN PARECHINUS ANGULOSUS BY ORGANIC POLLUTANTS: CORRELATION WITH MOLECULAR VALENCE CONNECTI-VITY INDICES.

Cape Town Univ. (South Africa). Dept. of Zoolo-

gy. R. P. Wynberg, A. C. Brown, and L. Hole. South African Journal of Marine Science SJMSE7, Vol. 8, p 313-317, 1989. 2 fig, 1 tab, 39 ref.

Descriptors: *Echinoderms, *Fertility, *Organic collutants, *Structure-activity relationships, *Water pollution effects, Fertilization, Mathematical studies, Molecular structure, Organic com-

The percentage fertilization of eggs of the urchin Parechinus angulosus, following exposure of the sperm to a variety of organic pollutants, was used to test the possibility of predicting toxicities from the consideration of molecular structure. A correlation is demonstrated between concentrations resulting in 50% inhibition of fertilization and the zero, first-order and second-order molecular-va-lence connectivity indices of the substances concerned. This correlation is more marked when a series of alcohols rather than a variety of non-alcoholic substances is used. A log or power expression best describes the relationship. (Author's abstract) W90-07248

SCIENTIFIC BASIS OF BIOASSAY.

Virginia Polytechnic Inst. and State Univ., Blacks-burg. Center for Environmental and Hazardous Material Studies

For primary bibliographic entry see Field 5A. W90-07250

RECENT DEVELOPMENTS IN AND INTER-COMPARISONS OF ACUTE AND CHRONIC BIOASSAYS AND BIOINDICATORS. Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.

For primary bibliographic entry see Field 5A. W90-07251

CHOICE AND IMPLEMENTATION OF ENVI-RONMENTAL BIOASSAYS.
Sheffield Univ. (England). Dept. of Animal and

For primary bibliographic entry see Field 5A.

W90-07252

APPLICATION OF BIOASSAYS IN THE RESO-LUTION OF ENVIRONMENTAL PROBLEMS; PAST, PRESENT, AND FUTURE.

Sheffield Univ. (England). Dept. of Animal and Plant Sciences For primary bibliographic entry see Field 5A. W90-07253

APPLICATION OF BIOASSAY TECHNIQUES TO WATER POLLUTION PROBLEMS.-THE UNITED KINGDOM EXPERIENCE.

Clyde River Purification Board, East Kilbride (Scotland). For primary bibliographic entry see Field 5A. W90-07254

USE OF ENVIRONMENTAL ASSAYS FOR IMPACT ASSESSMENT.

Pacific Northwest Research Foundation, Seattle,

For primary bibliographic entry see Field 5A. W90-07255

PROBING ECOSYSTEM HEALTH: A MULTI-DISCIPLINARY AND MULTI-TROPHIC DISCIPLINARY AND ASSAY STRATEGY.

Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences. For primary bibliographic entry see Field 5A. W90-07256

FUNCTIONAL BIOASSAYS UTILIZING ZOO-PLANKTON: A COMPARISON. Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology. For primary bibliographic entry see Field 5A.

HOLISTIC APPROACH TO ECOSYSTEM HEALTH ASSESSMENT USING FISH POPULATION CHARACTERISTICS.

Guelph Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field 5A. W90-07258

W90-07257

ENVIRONMENTAL IMPACT ASSESSMENT: THE GROWING IMPORTANCE OF SCIENCE IN GOVERNMENT DECISION MAKING. nent Review Office, Hull

For primary bibliographic entry see Field 6A. W90-07259

ROLE OF MICROBIAL METAL RESISTANCE AND DETOXIFICATION MECHANISMS IN ENVIRONMENTAL BIOASSAY RESEARCH. Guelph Univ. (Ontario). Dept. of Environmental

For primary bibliographic entry see Field 5A. W90.07260

PERFORMANCES OF THREE BACTERIAL ASSAYS IN TOXICITY ASSESSMENT, Centre des Sciences de l'Environment, Metz

For primary bibliographic entry see Field 5A. W90-07261

LUMINESCENT BACTERIA TOXICITY ASSAY IN THE STUDY OF MERCURY SPECIATION, Saskatchewan Univ., Saskatoon. Toxicology Re-

search Centre.
J. M. Ribo, J. E. Yang, and P. M. Huang.
Hydrobiologia HYDRB8, Vol. 188/89, p 155-162,
December 1989. 4 tab, 29 ref. Natural Sciences and
Engineering Research Council of Canada, Strategic Grant G1994-Huang. SIP Publication No.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

Descriptors: *Bioassay, *Chemical speciation, *Mercury, *Microtox assay, *Speciation, *Toxicity, *Water chemistry, Cysteine, Hydrogen ion concentration, Mercuric nitrate.

The toxicities of solutions of 10 mercury compounds to luminescent bacteria were measured using the Microtox Toxicity Bioassay in order to assess the influence that the counter-ions have on the aquatic toxicity of mercury salts. The toxicities of these mercury compounds were very similar, except for mercurous tannate and mercuric salicy-late. This can be attributed to differences in the late. This can be attributed to differences in the ionization and speciation patterns of these compounds relative to the other compounds tested. In general, the toxicity of the solutions at pH 5 was not significantly different from the toxicity of these solutions at pH 6, but a clear reduction in toxicity was observed when the pH of the solution was adjusted to pH 9. Significant differences were found between the toxicity of Hg(I) and Hg(II) salts of the same anion at pH 9. When cysteine was added to a mercuric nitrate solution (at pH 6). salts of the same anion at pH 9. When cysteine was added to a mercuric nitrate solution (at pH 6), a reduction in the toxicity was observed. This can be explained in terms of the strong binding of mercury to cysteine, thus reducing the concentration of mercury species available to cause an observable toxic effect to the bioluminescent bacteria. (Author's abstract) W90-07262

IS THE 'MICROBIAL LOOP' AN EARLY WARNING INDICATOR OF ANTHROPOGEN-IC STRESS.

IU STRESS.

Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 5A. W90-07263

BIOASSAY USING THE MEASUREMENT OF THE GROWTH INHIBITION OF A CILIATE PROTOZOAN: COLPIDIUM CAMPYLUM

SIURES.
Institut National de la Sante et de la Recherche Medicale, Villeneuve d'Ascq (France). Microbe Ecotoxicology Unit 146.
For primary bibliographic entry see Field 5A. W90-07265

APPLICATION OF ALGAL GROWTH POTEN-TIAL TESTS (AGP) TO THE CANALS AND LAKES OF WESTERN NETHERLANDS. Hoogheemraadschap van Rijnland, Leiden (Netherlands).

For primary bibliographic entry see Field 5A. W90-07266

STUDY OF PHOSPHATE LIMITATION IN LAKE MAARSSEVEEN: PHOSPHATE UPTAKE KINETICS VERSUS BIOASSAYS. Water Board of Utrecht (Netherlands). For primary bibliographic entry see Field 5A. W90-07267

EVIDENCE FROM ALGAL BIOASSAYS OF SEASONAL NUTRIENT LIMITATIONS IN TWO ENGLISH LAKES. Biological Association, Ambleside (England).

For primary bibliographic entry see Field 5A. W90-07268

EXAMINATION OF THE EFFECT OF WASTEWATER ON THE PRODUCTIVITY OF LAKE ZURICH WATER USING INDIGENOUS PHYTOPLANKTON BATCH CULTURE PHYTOPLANKTON BIOASSAYS.

BIOASSAYS. Zurich Univ., Kilchberg (Swizerland). Hydrobio-logical-Limnological Station. C. Lehmacher, and F. Schanz. Hydrobiologia HYDRB8, Vol. 188/89, p 229-235, December 1989. 2 fig, 2 tab, 26 ref.

Descriptors: *Bioassay, *Eutrophic lakes, *Lake
Zurich, *Phytoplankton, *Switzerland,
*Wastewater pollution, *Wastewater treatment,

*Water pollution effects, Biomass, Microbial production, Phosphates, Phosphorus, Tertiary treat-

Phytoplankton batch cultures were used to study the effect of biologically and chemically treated wastewater on algal growth in water from Lake Zurich. The guestion of whether the influence of Zurich. The question of whether the influence of sewage on the biomass production corresponds solely to the nutrient content of the sewage was also considered. The relationship between net microbial production (y, in 0.1 N KMnO4 consumption) and total phosphorus concentration (x, in microg P/L) was found to be characterized by the equation y = 2.12 in x-4.12. The fact that net microbial production is strongly dependent on equation y = 2.12 ln x-4.12. The fact that net microbial production is strongly dependent on total phosphorus concentration emphasizes the significance of the latter for the trophic state of Lake Zurich. It is assumed that the planned introduction of the quaternary purification stage with a high phosphorus removal in the sewage plants will accelerate the oligotrophication of the Lake Zurich. (Author's abstract) W90-07269

PHYTOPLANKTON RECOVERY RESPONSES AT THE POPULATION AND COMMUNITY LEVELS IN A HAZARD AND RISK ASSESS-MENT STUDY.

Institut National de la Recherche Scientifique,

Institut National de la Recherche Scientinque, Sainte-Foy (Quebec). P. Couture, C. Thellen, and P. A. Thompson. Hydrobiologia HYDRB8, Vol. 188/89, p 269-276, December 1989. 3 fig, 1 tab, 20 ref. Environment Canada and the Ministry of Supplies and Services UP-1ST83-00313; Natural Sciences and Engineer-ing Research Council of Canada Grant A8123.

Descriptors: *Bioassay, *Phytoplankton, *Pollutant identification, *Risk assessment, *Toxicity, *Water pollution effects, Adenylates, Algal physiology, Chlor-alkali effluent, Recovery, Selenas-

Both structural and functional relationships were investigated in experiments using Selenastrum ca-pricornutum populations and an indigenous microinvestigated in experiments using Selenastrum capricornutum populations and an indigenous microbial community. The purpose was to diagnose cellular stress and to predict recovery during exposures to a chlor-alkali effluent. Laboratory experiments demonstrated that the effluent was toxic at mens demonstrated that the effluent was toxic at concentrations greater or equal to 4 vol%. It ap-pears that during the exposure period, the func-tional parameters, particularly the intracellular adenylates ratios were reliable in predicting algal population recovery. In contrast, the river gradient experiments failed to demonstrate a toxic effect on community structure over the time coale studied. experiments failed to demonstrate a total effect of community structure over the time scale studied. Functional parameters revealed a significant effect on photosynthetic activity while adenylate energy charge was an insensitive indicator. The results tend to demonstrate that function responses, partend to demonstrate that function responses, par-ticularly intracellular adenylates ratios (ATP/cell; ATP/AMP) are appropriate to predict recovery responses to a toxicant at the population and com-munity levels. This would prove useful in enhanc-ing the ecological significance of toxicity tests in hazard assessment. (Author's abstract) W90-07273

FUNCTIONAL RESPONSE OF FUCUS VESI-CULOSUS COMMUNITIES TO TRIBUTYLTIN MEASURED IN AN IN SITU CONTINUOUS FLOW-THROUGH SYSTEM.

Stockholm Univ. (Sweden). Dept. of Zoology. C. Lindblad, U. Kautsky, C. Andre, N. Kautsky,

And M. Tedengren. Hydrobiologia HYDRB8, Vol. 188/89, p 277-283, December 1989. 3 fig, 1 tab, 25 ref.

Descriptors: *Algae, *Antifoulants, *Bioassay, *Organotin compounds, *Risk assessment, *Water pollution effects, Flow, Light, Metabolism, Nutri-ents, Oxygen, Photosynthesis, Pollution index, Salinity, Temperature.

The effects of antifouling paint leachate containing tributyltin on community metabolism and nutrient dynamics were measured in situ on natural com-munities dominated by Fucus vesiculosus. The measurements were made in two areas with different salinities and at various tributyltin concentra-tions up to about 5 microg/L. A portable continu-ous flow-through system was used in which the communities were incubated for a week. Continual measurements of oxygen, temperature, light and flow rate of water were made. A Perturbation Index (PI) and an Absolute Disturbance Index (ADI) were used to describe the changes due to treatment relativia to the control and to obtain (ADI) were used to describe the changes due to treatment relative to the control, and to obtain a total picture of disturbance using all measured parameters. Photosynthesis was particularly strongly affected and changes were obvious in oxygen production and nutrient uptake at tribulty-tim levels as low as 0.6 microg/L. (Author's abstract) W90-07274

ASSESSING TOXICITY OF LAKE DIEFEN-BAKER (SASKATCHEWAN, CANADA) SEDI-MENTS USING ALGAL AND NEMATODE BIOASSAYS.

Environmental Protection Service, Regina (Sas-katchewan). Water Quality Branch. For primary bibliographic entry see Field 5A. W90-07276

METAL CONTAMINATION IN SEDIMENTS AND BIOTA OF THE BAY OF QUINTE, LAKE ONTARIO, CANADA.

Queen's Univ., Kingston (Ontario). Dept. of Biol-

ogy. For primary bibliographic entry see Field 5A.

USE OF AQUATIC MACROPHYTES AS A BIO-ASSAY METHOD TO ASSESS RELATIVE TOX-ICITY, UPTAKE KINETICS AND ACCUMU-LATED FORMS OF TRACE METALS. King's Coll., London (England). Div. of Biosphere

For primary bibliographic entry see Field 5A.

BIOASSAYS WITH A FLOATING AQUATIC PLANT (LEMNA MINOR) FOR EFFECTS OF SPRAYED AND DISSOLVED GLYPHOSATE. Department of Fisheries and Oceans, (Manitoba). Freshwater Inst.

(Wallious). President inst.

W. L. Lockhart, B. N. Billeck, and C. L. Baron.

Hydrobiologia HYDRB8, Vol. 188/89, p 353-359,

December 1989. 1 fig, 3 tab, 24 ref.

Descriptors: *Agricultural runoff, *Aquatic plants, *Bioassay, *Duckweed, *Glyphosate, *Herbicides, *Toxicity, *Water pollution effects, Agricultural chemicals, Canada, Prairie wetlands.

Chemicals, Canada, Prairie Wetlands.

Macrophytes in forested areas and in prairie wetlands furnish critical habitat for aquatic communities and for several species of birds and mammals. North American agriculture relies heavily on herbicides and these compounds are detected routinely in surface waters of Western Canada. Common duckweed has been used previously in efforts to detect effects of herbicides and other chemicals. Duckweed clones were developed from local collections and grown axenically. The plants were exposed to glyphosate herbicide either by dissolving formulated Roundup (Monsanto Canada Inc.) in the culture media or by spraying of the cultures in a laboratory spray chamber. Plant growth was monitored by counting the fronds present on several occasions over a 2-week period. Plant growth, as measured by increased numbers of fronds or increased wet or dry weights was relatively insensitive to glyphosate dissolved in the culture medium. However, the plants were killed by application of glyphosate as a spray. (Author's abstract) W90-07281 W90-07281

DO BIOASSAYS ADEQUATELY PREDICT EC-OLOGICAL EFFECTS OF POLLUTANTS.

Oslo Univ. (Norway). Dept. of Marine Zoology and Chemistry. and Chemistry.
For primary bibliographic entry see Field 5A.

Group 5C-Effects Of Pollution

LIFE-TABLES OF DAPHNIA OBTUSA (KURZ) SURVIVING EXPOSURE TO TOXIC CONCEN-TRATIONS OF CHROMIUM.

Latituto Italiano di Idrobiologia, Pallanza (Italy). L. Coniglio, and R. Baudo. Hydrobiologia HYDRB8, Vol. 188/89, p 407-410, December 1989. I fig. 1 tab, 24 ref.

Descriptors: *Bioassay, *Chromium, *Daphnia, *Toxicity, Growth, Life tables, Mortality, Reproduction, Statistical analysis.

The life-tables of Daphnia obtusa surviving a 48 hr exposure to various hexavalent chromium concen-trations have been used to assess whether or not trations have been used to assess whether or not the toxicant had affected demographic parameters. D. obtusa cohorts were exposed to seven different concentrations (20 to 140 microg Cr/L); the surviving animals were then transferred into clean water to grow in optimal conditions until the death of the last individual. The resulting life-tables were then used to assess if the toxicant might in some then used to assess if the toxicant might in some way affect demographic parameters such as survivorship curves, age specific mortality, age specific fertility and fecundity, survivorship-weighted fertility and fecundity, survivorship-weighted fertility and fecundity, seperation length, mean mortality rate, mean expectation of life of cohort at birth, intrinsic rate of natural increase and finite rate of increase, net reproduction rate. The statistical comparison led to the conclusion that even such a short exposure to a relatively low level of chromium reduces the life-span, delays the time of first reproduction, shortens the reproduction period, and decreases the brood size. (White-Reimer-PTT) W90-07287

TOXICITY OF THE NEW PYRETHROID IN-SECTICIDE, DELTAMETHRIN, TO DAPHNIA

Institute of Environmental Health and Engineering, Beijing (China).
For primary bibliographic entry see Field 5A.
W90-07288

HERBICIDE EFFECTS ON PLANKTONIC SYS-TEMS OF DIFFERENT COMPLEXITY, Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). For primary bibliographic entry see Field 5A. W90-07289

PHYSIOLOGICAL BACKGROUND FOR USING FRESHWATER MUSSELS IN MONI-TORING COPPER AND LEAD POLLUTION.
Balatoni Limnologiai Kutato Intezete, Tihany For primary bibliographic entry see Field 5A. W90-07292 (Hungary).

APPLICATION OF COMBINED TISSUE RESI-DUE CHEMISTRY AND PHYSIOLOGICAL MEASUREMENTS OF MUSSELS (MYTILUS EDULIS) FOR THE ASSESSMENT OF ENVI-RONMENTAL POLLUTION.

Marine Biological Association of the United King-dom, Plymouth (England). For primary bibliographic entry see Field 5A. W90-07293

BIOLOGICAL ASSESSMENT OF CONTAMI-NATED SEDIMENT—THE DETROIT RIVER EXAMPLE.

National Water Research Inst., Burlington (Ontar-

For primary bibliographic entry see Field 5A.

METHOD FOR STUDYING THE IMPACT OF POLLUTED MARINE SEDIMENTS ON IN-TERTIDAL COLONISING ORGANISMS; TESTS WITH DIESEL-BASED DRILLING MUD AND TRIBUTYLTIN ANTIFOULING MUD AND PAINT.

Ministry of Agriculture, Fisheries and Food, Burn-ham on Crouch (England). Fisheries Lab. For primary bibliographic entry see Field 5A.

W90-07295

SCOPE FOR GROWTH IN GAMMARUS PULEX, A FRESHWATER BENTHIC DETRITI-

Sheffield Univ. (England). Dept. of Animal and For primary bibliographic entry see Field 5A. W90-07298

FEEDING AND NUTRITIONAL CONSIDER-ATIONS IN AQUATIC TOXICOLOGY.
Waterloo Univ. (Ontario). Dept. of Biology.
R. P. Lanno, B. E. Hickie, and D. G. Dixon.
Hydrobiologia HYDRB8, Vol. 188/89, p 525-531,
December 1989. I fig. 1 tab, 36 ref. Natural Sciences and Engineering Research Council of
Canada Operating Grant A8155.

Descriptors: *Aquatic fauna, *Bioassay, *Laboratory methods, *Nutrition, *Toxicity, *Toxicology, Acute effects, Chronic effects, Feeding regime,

The nutritional status of an aquatic organism, both ne nutritional status of an aquatic organism, ooth prior to and during testing, can significantly modify the apparent toxicity of a chemical. In order to decrease the variability of toxicity test results, both within and between laboratories, feedorder to decrease the variability of toxicity test results, both within and between laboratories, feeding regimes, feed types and proximate composition of diets should be routinely reported. The advantages and metabolic effects of various feeding practices currently used in toxicity testing (fasting, starvation, feeding as a percentage of body weight, feeding ad libitum and pair feeding) were evaluated. The disadvantages of monitoring nutritional status of test organisms were also reviewed and methods suggested as to how to monitor nutritional status. The feeding regime selected will vary depending on whether the test is acute or chronic and on whether it is conducted in a static or a flow-through system. One must also consider the species tested and the life stage of the organism. The toxicological endpoints being monitored are also a factor since feeding may not be as important if lethality is being monitored over a short period of time with relatively large organisms. However, it may be very important if the physiological parameters of interest are affected by fasting. (White-Neurolph 1997) Reimer-PTT)

HYPOTHESIS FORMULATION AND TEST-ING IN AQUATIC BIOASSAYS: A DETERMI-NISTIC MODEL APPROACH.

Lakehead Univ., Thunder Bay (Ontario). Dept. of Biology. nary bibliographic entry see Field 5A. For primar W90-07300

IN SITU AND LABORATORY STUDIES ON THE BEHAVIOR AND SURVIVAL OF PACIFIC SALMON (GENUS ONCORHYNCHUS). Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.

I. K. Birtwell, and G. M. Kruzynski. Hydrobiologia HYDRB, Vol. 188/89, p 543-560, December 1989. 5 fig, 5 tab, 38 ref.

Descriptors: *British Columbia, *Estuaries, *Fish Descriptors: "British Columbia, "Estuaries, Fish behavior, "Pulp wastes, "Salmon, "Wastewater pollution, "Water pollution effects, Dissolved oxygen, Hydrogen ion concentration, Hypoxic conditions, In situ tests, Industrial wastewater, Salinity, Stratification, Water temperature.

Many estuaries in British Columbia are vertically stratified with a shallow, well-defined halocline which can restrict the dispersion of wastes discharged into less saline surface waters and impose constraints upon aquatic organisms. In situ experiments in an estuary receiving a surface discharge of treated pulp mill wastes, revealed conditions which were lethal to underpearling salmon at, and below the halocline (4.0-6.5 m depth). Behavioral bioassays determined that juvenile chinook salmon were biased towards the water surface and avoided were biased towards the water surface and avoided waters at depth. Dissolved oxygen was the vari-able which affected this distribution most signifi-

cantly. Surface waters receiving effluent from another pulp mill were lethal to juvenile salmon within 350 m, and a significant vertical avoidance response occurred within 350-950 m of the outfalls. response occurred within 350-950 m of the outfalls. The behavioral response was significantly correlated with in situ temperature, pH and color (effluent). As a complement to field experiments a water column simulator to examine salmon behavior in the laboratory was developed. The surface water orientation behavior of juvenile salmon in relation to variations in salinity and dissolved oxygen was investigated. Under simulated vertically stratified estuarine conditions, the fish moved freely between overlying fresh water and salt water. Induction of hypoxic conditions in fresh water elicited: a downward distribution shift towards the halocline and hypoxic conditions in fresh water elicited: a downward distribution shift towards the halocline and oxygenated, but more saline, waters. Avoidance reactions (50% level) occurred consistently up to 7-8 mg/L dissolved oxygen. Salmon continued to examine the hypoxic freshwater zone despite suboptimal conditions. (Author's abstract) W90-07301

USE OF SHEEPSHEAD MINNOW (CYPRINO-DON VARIEGATUS) AND A BENTHIC COPE-POD (TISBE BATTAGLIA) IN SHORT-TERM TESTS FOR ESTIMATING THE CHRONIC TOXICITY OF INDUSTRIAL EFFLUENTS. Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
For primary bibliographic entry see Field 5A.
W90-07303

IDENTIFICATION OF DEVELOPMENTAL TOXICANTS USING THE FROG EMBRYO TERATOGENESIS ASSAY-XENOPUS (FETAX). Oklahoma State Univ., Stillwater. Dept. of Zoolo-

For primary bibliographic entry see Field 5A.

CELLULAR AND BIOCHEMICAL INDICA-TORS ASSESSING THE QUALITY OF A MARINE ENVIRONMENT. Quebec Univ., Rimouski.

For primary bibliographic entry see Field 5A. W90-07306

ROLE AND APPLICATION OF ENVIRON-MENTAL BIOASSAY TECHNIQUES IN SUP-PORT OF THE IMPACT ASSESSMENT AND DECISION-MAKING UNDER THE OCEAN DUMPING CONTROL ACT IN CANADA. Environmental Protection Service, Dartmouth (Nova Scotia). Marine Environmental Branch. For primary bibliographic entry see Field 5E. W90-07307

IN SITU BIOASSESSMENT OF DREDGING AND DISPOSAL ACTIVITIES IN A CONTAMI-NATED ECOSYSTEM: TORONTO HARBOR. Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.

M. Munawar, W. P. Norwood, L. H. McCarthy, and C. I. Mayfield.

Hydrobiologia HYDRB8, Vol. 188/89, p 601-618, December 1989. 6 fig, 5 tab, 19 ref.

Descriptors: *Bioassay, *Dredging wastes, *Plankton, *Sediment contamination, *Toronto Harbor, *Toxicity, *Water pollution effects, Don River, Impact assessment, In situ tests, Industrial wastewater, Productivity, Size, Wastewater pollu-

The contamination of Toronto Harbor is a very Ine contamination of Toronto Harbor is a very serious problem. The major sources of pollution are the Don River and sewer outflows, as well as industrial, and municipal effluents. The problem is further compounded by perturbations of the toxic sediment caused by dredging, dredge-disposal, navigation, and recreational activities. The impact of contamination and nutrient enrichment was reflected in the size-fractionated primary productivity experiments. Generally, microplankton/net-plankton (>20 microm) productivity was en-

Effects Of Pollution-Group 5C

hanced whereas ultraplankton (<20 microm) productivity was inhibited. These observations are attributable to interactions between ameliorating nutrients and toxic contaminants as well as to the differential sensitivity of natural phytoplankton size assemblages to the bioavailable chemical size assemblages to the bioavailable chemical regime. In situ environmental techniques applied in Toronto Harbor were effective, sensitive, and rapid, and provided a better understanding of the impact of dredging/disposal activities under natural conditions. These techniques have great potential in the assessment of the ecotoxicology of harbors and other stresses environments. (Author's

ASSESSING THE IMPACT OF EPISODIC POL-

Water Research Centre, Medmenham (England).

Water Research Centre, Including Medmenham Lab.
J. Seager, and L. Maltby.
Hydrobiologia HYDRB8, Vol. 188/89, p 633-640, December 1989. 3 fig, 18 ref.

Descriptors: *Bioassay, *Environmental impact, *Episodic pollution, *Toxicity, *Water pollution effects, Model studies, Prediction, Rainfall, Time series analysis, Water quality.

Episodic pollution, particularly from farm wastes and combined sewer overflows continues to pose a and combined sewer overflows continues to pose major problem, and is one of the main causes of major problem, and is one of the main causes of poor quality rives. However, the majority of ecotoxicological studies to date have been concerned with the effects of continuous exposure. Although such studies may provide a means of predicting the impact of episodic pollution events, a more appropriate test design would be to assess toxicity under pulsed and fluctuating exposure. A review of the results of reported studies relevant to the investigation of episodic pollution paying particular attention to the effects of magnitude, duration and frequency of exposure is presented. The prediction of responses of aquatic organisms to pulses of pollutants involves one of two approaches; either direct experimentation under controlled conditions, or experimentation under controlled conditions, or the application of dynamic models to data from more conventional continuous exposure bioassays.
Water quality models based on rainfall time series data are being developed that will allow the prediction of impacts of intermittent discharges on receiving water quality in terms of magnitude, duration, and frequency of events. (White-Reimer-PTT) W90-07310

ACUTE TOXICITY OF INDUSTRIAL AND MU-NICIPAL EFFLUENTS IN THE STATE OF MARYLAND, USA: RESULTS FROM ONE YEAR OF TOXICITY TESTING. Johns Hopkins Univ., Laurel, MD. Applied Phys-

For primary bibliographic entry see Field 5A. W90-07311

RESTORATION OF FISH COMMUNITIES OF

RESTORATION OF FISH COMMUNITIES OF THE RHINE RIVER TWO YEARS AFTER A HEAVY POLLUTION WAVE, Forschungsinstitut und Natur-Museum Sencken-berg, Frankfurt am Main (Germany, F.R.). A. Lelek, and C. Kohler. Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 1, p 57-66, January/Febru-ary 1990. 4 fig, 2 tab, 12 ref.

Descriptors: *Rhine River, *River fisheries, *Self-purification, *Species composition, *Water pollu-tion effects, *West Germany, Biotic communities, History, Long-term changes, Pesticides, Spills,

The Rhine River, a former salmonid river, has been transformed into a ship canal. Pollution increased steadily into the 1960s and 1970s. Improved water quality in the 1980s was followed by an increase in abundance of several species and in faunal diversity. Originally 47 spp. of fish inhabited the Rhine; now 40 indigenous and 15 introduced species live in the river. In November 1986, a heavy pollution wave resulted from the Sandoz

Accident in which a fire in a storehouse containing fungicides and insecticides led to the introduction into the river of pesticides and fire-fighting wastes Two determine what lasting effect this incident had, if any, fish were sampled by electrofishing at 200 stations between Basel, Switzerland, and Emmerich, near the Dutch border, a stretch of almost 700 km. More than 19,000 individuals were ob-700 km. More than 19,000 individuals were outsined. Despite early concerns to the contrary the Rhine fish fauna was not severely damaged by the Sandoz Accident. Most of the changes in the fauna occurred much earlier, between 1890 and 1950, so that the post-accident fish fauna is not substantially different from the pre-accident fauna, which was already considerably altered from the natural fauna of the Rhine. (Rochester-PTT)

CADMIUM EXPOSURE AND HEALTH EFFECTS AMONG RESIDENTS IN AN IRRIGATION AREA WITH ORE DRESSING TION AREA WASTEWATER.

Institute of Environmental Health and Engineering, Beijing (China). S. Cai, L. Yue, Z. Hu, X. Zhong, and Z. Ye.

Science of the Total Environment STI 90, p 67-73, January 1990. 3 tab, 10 ref. ent STENDL, Vol.

Descriptors: *Cadmium, *China, *Mine wastes, *Public health, *Wastewater irrigation, Human diseases, Path of pollutants, Pathology, Tissue analysis, Toxicity, Tungsten ore.

About 0.05 mg/L Cd was found in irrigation water contaminated by wastewater discharged from tungsten ore dressing plants, and about 1 mg/kg tungsten ore dressing plants, and about 1 mg/kg Cd was found in irrigated acid soils. The main sources of Cd intake by residents of the polluted areas (Dayu County, China) are agricultural products. The average intake of Cd was 367-382 microgram/day and for smokers 417 microgram/day. Among the residents who have been exposed to Cd for more than 25 yr, cadmium adsorption (urinary Cd > or = 10 microgram/g creatinine) was 60% and an early effect on the target organ (urinary beta2-microglobulin > or = 500 microgram/g creatinine and urinary beta2-microglobulin > or = 500 microgram/g creatinine) was detected in 17% of a sample of 433 persons. Levels of urinary Cd and blood Cd exceeded the critical value in the exsample of 435 persons. Levels of urnary Ca and blood Cd exceeded the critical value in the exposed group. The concentrations of urinary calcium, beta2-microglobulin and N-acetyl-beta-D-glucosaminidase were significantly high in residents of contaminated areas than in those of control areas. contaminated areas than in those of control areas. Case-control studies of residents show that many have suffered from a nephropathy with tubulo-interstitial abnormalities. Owing to the combined Cd effect, the cases with fractional beta2-microglobulin excretion > 0.10 were 46.6% in the exposed population, and were much higher than in the control group (20.3%). (Author's abstract) W90-07340

TRICHLOROETHYLENE: SPONSIBLE REACTION OR OVERKILL Oregon State Univ., Corvallis. Dept. of Civil Engineering. For primary bibliographic entry see Field 5G. W90-07364

GEOTOXICOLOGY OF MULTIPLE SCLERO-SIS: THE HENRIBOURG, SASKATCHEWAN, CLUSTER FOCUS: I. THE WATER.

Saskatchewan Univ., Saskatoon. Toxicology Research Centre.

Science of the Total Environment STENDL, Vol. 84, p 45-59, August 1989. 1 fig, 3 tab, 34 ref.

Descriptors: *Epidemiology, *Human diseases, *Saskatchewan, *Trace elements, *Water chemistry, *Water pollution effects, Barium, Calcium, Chlorides, Chromium, Geochemistry, Magnesium, Manganese, Molybdenum, Nitrates, Nitrites, Sele-

Some childhood-related, geographically-linked factor predisposes towards (or protects against) multiple sclerosis (MS). To test this hypothesis, the chemical characteristics of the water used by Hen-

ribourg, Saskatchewan, a representative geographical cluster-foci for MS, is compared and contrasted with appropriate norms from North America, and with the chemistry of an area of Saskatchewan where both the incidence of MS and the frequency where both the incidence of MS cases, are very low. Water samples in Henribourg were taken from two wells, one of which was known to have been the water supply for at least two persons who subsequently developed MS, and the other provided water for the school and all but two of the dwellings involved. Another sample was drawn from the nearby river where the MS victims had played as children. The samples were taken according to standard methods and analyzed by a single analytical laboratory using standard methods, with the exception of selenium, which was analyzed in a laboratory specializing in the environmental behavior of this element. Overall, the results suggest that an environment predisposing to MS may have a number of water chemistry characteristics such as: relative deficiency of selenium and sulfate, but relative abundance of barium, calcium, chloride, chromium, magnesium, manganese, molybdenum, suiteste streative accessive. of childhood homes of MS cases, are very low. relative abundance of barium, calcium, chloride, chromium, magnesium, manganese, molybdenum, nitrate plus nitrite, strontium and zinc. Possible explanations for the apparent link between the excess rate of MS and the water geochemistry findings at Henribourg include: predisposition to the disease from the presence of or lack of a certain element, a direct toxic effect of an element, in present of increasing disease. certain element, a direct toxic effect of an element, a passive role of an element in increasing disease risk, a modulating role of an element in increasing the functional effectiveness of infective or parasitic organisms or of their alternate hosts or vectors, and other more insidious etiologies. (Author's abstract) stract) W90-07390

MUTAGENIC ACTIVITY IN GROUNDWATER IN RELATION TO MOBILIZATION OF ORGANIC MUTAGENS IN SOIL.

Stichting Waterlaboratorium Oost, Doetinchem (Netherlands).

Kvedicardinals, K. F. Van Kreyl, and S. Persad. Science of the Total Environment STENDL, Vol. 84, p 185-199, August 1989. 8 fig. 1 tab, 13 ref.

Descriptors: *Groundwater pollution, *Leaching, *Mutagenicity, *Mutagens, *Soil chemistry, *Water pollution sources, Drinking water, Groundwater, Organic matter, Percolation, Rain, Soil water, The Netherlands.

The presence of mutagenic activity (Ames Salmonella-microsome assay) in different types of uncontaminated Dutch soils was demonstrated in soil samples taken at four locations in The Netherlands. mples were prepared for column elution with different organic solvents or with water. Solvents were removed by rotary evaporation and dry residues were dissolved in dimethylsulfoxide. residues were assolved in dimentifysulfoxide. Eluates were tested for mutagenicity by the Ames Salmonella-microsome assay with rat liver S-9, induced by Aroclor 1234. The mutagenic activity of the soil was mobilized by eluting the soils with organic solvents. The highest mutagenic activity was obtained using dimethylsulfoxide as solvent. The organic mutagens could also be mobilized by The organic mutagens could also be mobilized by percolating the soils with rain water, although this phenomenon was not always observed. These find-ings suggest that the organic mutagens found in groundwater may, at least in part, arise from mobi-lization of organic mutagens in soil by rain water. (Geiger-PTT) W90-07397

MUTAGENIC ACTIVITY AND PRESENCE OF THE STRONG MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2-(5H)-FURANONE (MX) IN CHLORINATED RAW AND DRINKING WATERS IN THE NETHER-LANDS.

Abo Akademi, Turku (Finland). Dept. of Organic

Chemistry.

P. Backlund, E. Wondergem, K. Voogd, and A. de

Science of the Total Environment STENDL, Vol. 84, p 273-282, August 1989. 2 fig, 2 tab, 33 ref.

Group 5C-Effects Of Pollution

Descriptors: *Chlorination, *Drinking water, *Mutagens, *Raw water, *The Nether-Descriptors: Citothianon, Prinain Agenicity, Mutagens, Raw water, The Netherlands, Water pollution effects, Water pollution sources, Water treatment, Activated carbon, Chlorine, Coagulation, Filtration, Ozonation, Sur-

Chlorinated surface and drinking waters in The Netherlands were analyzed for mutagenic activity (Ames test) and the strong mutagen 3-chloro-4 (dichloromethyl)-5-hydroxy-2(5H)-furanone (MX). Mutagenic activity and MX were formed during chlorine treatment of raw surface waters and purfulent to the contract of the contr chlorine treatment of raw surface waters and purified surface water. Mutagenicity was also present in finished drinking waters which had been subjected to post-chlorination, but no MX could be detected. It is proposed that the mutagens responsible for most of the activity are acidic compounds as they were mainly extractable under acidic continuous formed during post-chlorination of drinking water were efficiently removed by use of ozonation/activated carbon filtration. On the other hand, coagulation (Fe(III)) in the presence of activated carbon powder seemed to have hardly any effect on the mutagen precursors. The calculated mutagenicity contribution from MX to the observed Salmonella typhimurium strain TA100 activity in the waters studied was <20%. (Author's abstract) abstract) W90-07400

EFFECTS OF WATERING AND SIMULATED ACID RAIN ON QUANTITY OF PHYLLOS-PHERE FUNGI OR BIRCH LEAVES.
Turku Univ. (Finland). Dept. of Biology.
M. L. Helander, and A. Rantio-Lehtimaki.
Microbial Ecology MCBEBU, Vol. 19, No. 1, p
119-125, January/February 1990. 2 fig, 2 tab, 19
ref

Descriptors: *Acid rain, *Acid rain effects, *Birch trees, *Fungi, *Trees, Hydrogen ion concentration, Microflora, Nitric acid, Phyllosphere fungi, Simu-lated rainfall, Sulfuric acid.

The effects of simulated acid rain on the popula-The effects of simulated acid rain on the population of birch phyllosphere fungi and species/genera/group composition of fungi on birch leaves were investigated in a field study in the subarctic region of northern Finland. The acid rain treatments consisted of a mixture of sulfuric acid and nitric acid with a mass ratio of 2.86:1 (S:N) with acidities of pH 4 and pH 3. Dry control plots received only natural precipitation; irrigated control plots received spring water (pH 6) in a volume equal to the acid treatment plots. Treatments began in 1985. Culturing of the fungi inhabiting the birch equal to the acid treatment plots. I reatments began in 1985. Culturing of the fungi inhabiting the birch leaves was performed five times during the summer of 1988. The number of fungal colonies was significantly decreased on one of five sampling dates in the pH 4 treatment and on three of five sampling dates in the pH 3 treatment. Irrigation with spring water did not have a significant effect. The acid rain treatments affected the microflora of the upper branches (at a height of 2m) and of the lower branches (at a height of 0.5 cm) equally. The lower branches (at a height of 0.5 cm) equally. The lower branches had significantly more fungi than the upper ones on three of five sampling dates. The number of phyllosphere fungi isolated from birch leaves was greater in late summer than in early summer. The most abundant taxon (ca. 80%) was Aureobasidium pullulans, followed by Hormonema sp. and zygomycetes. (Author's abstract) W90-07413

CYANOBACTERIA (BLUE-GREEN ALGAE) IN WISCONSIN WATERS: ACUTE AND CHRON-

Wisconsin Univ.-Madison. Lab. of Hygiene. For primary bibliographic entry see Field 2H. W90-07425

DEVELOPMENT OF CRITICAL LIFE STAGE ASSAYS: TERATOGENIC EFFECTS OF ASH BASIN EFFLUENT COMPONENTS ON FRESHWATER FISH, GAMBUSIA AFFINIS AND DAPHNIA.

Voorhees Coll., Denmark, SC. M. S. Guram, and B. Boatwright. Available from the National Technical Information Service, Springfield, VA. 22161, as DE88-011510. Price codes: A03 in paper copy, A01 in microfiche. Report No. DOE/SR/18001-1, April 6, 1988. 29p, 37 fig. DOE Contract DOE/SR/18001-1.

Descriptors: *Daphnia, *Fish, *Fisheries, *Gambusia, *Life history studies, *Savannah River Plant, *Teratogenic effects, *Water pollution effects, Ash, Toxicity.

The Voorhees College research project directed toward describing and evaluating the reproductive toward describing and evaluating the reproductive activity of a representative fish species (Gambusia) in several ponds on the Savannah River Project (SRP) property has established several important points during the first phase (year 1) of its operation. It has been demonstrated that significant numbers of the selected fish can be obtained from each of the test ponds, and can be returned to the Voorhees College laboratories in good physiological condition. Forty individual fry rearing tanks are now functioning with capture of fry being carried out as they are delivered by each female fish. Preservation of fry is made in Bouins solution for detailed analysis of any ahoromalities. The goal of the first phase is to establish a year long (several seasons) profile of the number of fry delivered per female fish, presence or absence of abnormal fry at birth, variation in fry between successive deliveries of fry. variations throughout the year, and variations throughout the year. each of the test ponds, and can be returned to the of fry, variations throughout the year, and variations of fry characteristics between the several ponds from which the adult female fish were obtained. Several additional objections have been tained. Several additional objectives have been added to the overall plan of research. These have added to the overall plan of research. These have arisen due to experience in conducting the initial phase of the experimental protocol, and include: (1) additional ponds on the SRP will be visited and pregnant (gravid) Gambusia collected from each. Approximately 20 females will be collected, placed in individual tanks, and fry recovered as they are born; (2) additional rearup tanks and pumps will be necessary to handle the increased population of gravid female Gambusia to be collected; and (3) it is proposed to run parallel studies of fish and their gravid temale Gambusa to be collected; and (3) it is proposed to run parallel studies of fish and their fry from each pond. One series would allow the fry to develop for further observation and measurements over a period of several weeks or months. (Lantz-PTT)

W90-07463

BIOLOGICAL TESTING OF SEDIMENT FOR THE OLYMPIA HARBOR NAVIGATION IM-PROVEMENT PROJECT, 1988: GEODUCK, AMPHIPOD, AND ECHINODERM BIOAS-

SAYS.

Battelle Pacific Northwest Labs., Sequim, WA.

Marine Research Lab.

J. A. Ward, J. Q. Word, and L. D. Antrim.

Available from the National Technical Information
Service, Springfield, VA. 22161, as DE89-011355.

Price codes: A04 in paper copy, A01 in microfiche.
Report No. PNL—6883, May 1989. DOE Contract
DE-AC06-76RL0-1830.

Descriptors: *Bioassay, *Dredging wastes, *Puget Sound, *Sediment analysis, *Waste disposal, *Water pollution effects, *Water pollution preven-tion, Amphipods, Clams, Echinoderms, Laborato-ry methods, Lethal limit, Mortality, Olympia Harbor, Oysters, Toxicity, Washington.

The Olympia Harbor Navigation Improvement Project requires the dredging of about 330,000 cu yd of sediment from the harbor entrance channel and 205,185 cu yd from the turning basin. Puget Sound Dredged Disposal Analysis (PSDDA) partial characterization studies were used to plan a full sediment characterization in which chemical analysis secument characterization in which chemical analy-ses and biological testing of sediments evaluated the suitability of the dredged material for uncon-fined, open-water disposal. The Army Corps of Engineers, Seattle District contracted with other Engineers, Seattle District contracted with other government facilities to perform flow-through solid phase bioassays utilizing juvenile geoduck clams, and static solid phase bioassays using the phoxocephalid amphipod, Rhepoxynius abronius, developing embryos and gametes of the purple sea urchin, Strongylocentrotus purpuratus, and the larvae of the Pacific oyster Crassostrea gigas. The results of the geoduck protocol development test showed that juvenile geoducks are capable of sur-

viving in both coarse and fine-grained substrates for a period exceeding 10 days, with an optimum sediment depth in the test containers of 2 cm. The definitive test results indicated no significant difference between Olympia Harbor (test) and reference sediment treatment. Amphipod tests indicated that none of the test treatments were statistically different from reference sediment treatments. In coment from reference sediment treatments. In com-parison to control sediment treatments, four of the test treatments had statistically significant re-sponses which ranged from 22 to 31% below con-trol treatment response. The sea urchin larval de-velopment tests showed that none of the test treatments were statistically different from the reference sediment treatment. However, all of the test treatments had at least a 40% greater mortality in comparison to control treatments. The oyster larvae tests were not valid due to unacceptably high control mortality. When the results of these biological tests were evaluated under PSDDA guidelines, it was found that all the tested sediment treatments from Olympia Harbor are suitable for unconfined open-water disposal. (Author's abstract) W90-07500

SHORT-TERM METHODS FOR ESTIMATING THE CHRONIC TOXICITY OF EFFLUENTS AND RECEIVING WATERS TO MARINE AND ESTUARINE ORGANISMS.

ESTUARINE ORGANISMS.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-220503.
Price codes: A18 in paper copy, A01 in microfiche.
Report No. EPA-600/4-87/028, May 1988. 427p, 2
fig. 1 tab, 285 ref, 7 append. Editect by Cornelius I. Weber, William B. Horning, Donald J. Klemm, Timothy W. Neiheisel, Philip A. Lewis, and Ernest L. Robinson.

Descriptors: *Chronic toxicity, *Data interpreta-tion, *Estuarine environment, *Marine environ-ment, *Toxicity, *Toxicology, *Water pollution effects, Algae, Bioassay, Biological studies, Echin-oderms, Handbooks, Laboratory methods, Minnow, Mysids, Silverside.

Six short-term (one-hour to nine-day) methods are described for estimating the chronic toxicity of effluents and receiving waters to five species: the aheepshead minnow, Cyprinodon variegatus; the inland silverside, Menidia beryllina; the mysid, Mysidopsis bahia; the sea urchin, Arbacia punctulata; and the red, macroalgae, Champia parvula. Also included are guidelines on laboratory safety, quality assurance, facilities and equipment, dilution water, effluent sampling and holding, data analysis, report preparation, and organism culturing and handling. Listings of computer programs for Dunnett's Procedure and Probit Analysis are provided in the Appendix. (Author's abstract) W90-07505

5D. Waste Treatment Processes

DESAL-5 MEMBRANE FOR WATER SOFTEN-ING.

Desalination Systems, Inc., Escondido, CA. For primary bibliographic entry see Field 5F. W90-06562

OPTIMIZATION OF SLUDGE ANAEROBIC DIGESTION BY SEPARATION OF HYDROLY-SIS-ACIDIFICATION AND METHANOGENE-

Lyonnaise des Eaux, Le Pecq (France). Lab. Cen-

C. Perot, and D. Amar. Environmental Technology Letters ETLEDB, Vol. 10, No. 7, p 633-644, July 1989. 5 fig, 4 tab, 15

Descriptors: *Hydrolysis, *Methanogenesis, *Sludge digestion, *Wastewater obic digestion, Sludge treatment.

In order to provide better environmental protec-tion, wastewater treatment methods have become

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

increasingly effective. However, for a given volume of effluent, sludge production is gradually increasing. Consequently, sludge treatment costs are also rising. As a result, improvement of organic matter degradation efficiency has become neces-sary. In this study, a two-phase anaerobic digestor with an optimized hydrolysis-acidification reactor was compared with a single-step digestor for mu-nicipal mixed sludge. Results from the two procnacipal mixed sludge. Results from the two proc-esses were compared using the statistical test of Behrens-Fisher. Advantages of the two-phase di-gestor are: steady-state conditions are reached after 45 days instead of 75 days for the single-stage process; volatile suspended solids are 60% degrad-ed instead of 40% degraded; and retention time decreased from 25 days to 11.6 days. This study demonstrates the advantages of optimizing the limiting step in anaerobic sludge digestion in order to increase the degradation efficiency. (Brunone-PTT) W90-06614

PERFORMANCE AND KINETICS OF AN ACTIVATED SLUDGE SYSTEM TREATING WASTEWATER CONTAINING BRANCHED ALKYLBENZENE SULPHONATES.
Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Chemical Engineering.
M. A. Hashim, J. Kulandai, and R. S. Hassan.
Environmental Technology Letters ETLEDB, Vol. 10, No. 7, p 645-652, July 1989. 4 fig, 3 tab, 15 ref.

Descriptors: *Activated sludge, *Alkylbenzene sulfonates, *Detergents, *Wastewater treatment, Biodegradation, Biological oxygen demand, Chemical oxygen demand, Enzymes, Solids retention time, Water pollution effects.

The presence of recalcitrant detergents in wastewaters are known to cause problems in rivers as well as in sewage treatment plants. These problems include toxicity to microorganisms and fish, as well as in sewage treatment plants. These problems include toxicity to microorganisms and fish,
reduction of oxygen transfer into water, eutrophiication, and foaming which results in the transmission of pathogenic microorganisms and the removal of active biomass into the foam layer. Treatment
of a wastewater containing high concentrations of
branched alkylbenzene sulphonates, 123 to 250
mg/liter methylene blue active substances
(MBAS), was achieved through an activated
sludge system with recycling. The biological
savgen demand, chemical oxygen demand, and
MBAS levels of the recalcitrant wastewater were
reduced by 87%, 68%, and 69%, respectively. The
high value of the substrate saturation constant (111
mg/liter) found for this recalcitrant wastewater
indicates a lack of affinity by the enzymes to the
substrate present. The use of such an activated
sludge system with recycle is an effective method
in the treatment of a wastewater containing high
levels of branched ABS. Given an adequate acclimatization period, together with the proper choice
of solids retention time, the recalcitrant
wastewater can be successfully treated. (BrunonePTT)
W90.06615 PTT) W90-06615

SIMULTANEOUS REMOVAL OF FLUORIDE AND PHOSPHATE BY FLUOROAPATITE CRYSTALLIZATION WITH SINTERING PEL-LETS OF ACTIVATED SLUDGE ASH.
Kumamoto Univ. (Japan). Dept. of Civil and Envi-

Numamoto Univ. (apan), Dept. of Civil and Environmental Engineering. S. Nakajima, H. Harada, and K. Tanaka. Environmental Technology Letters ETLEDB, Vol. 10, No. 7, p 653-660, July 1989. 10 fig, 1 tab,

Descriptors: *Activated sludge, *Crystallization, *Fluorides, *Phosphates, *Wastewater treatment, Ash, Hydrogen ion concentration, Kinetics, Satu-ration index, Temperature.

The effluent from integrated circuit production is a major source of contamination by fluoride in wastewater. A method of fluoride treatment by fluoroapatite crystallization is described which can simultaneously remove fluoride and phosphate. For the purpose of recycling waste activated sludge, sintering pellets of sludge were used as a

seed for crystallization in batch experiments. The crystallization reaction follows a second-order kinetic law. The reaction constant is dependent upon initial pH, saturation index (SI), and ambient temprature. The reaction constants were proportional to both the -1.7 power of initial SI and the 4.8 power of the initial pH. Free activated energy was 10.13 kilojoules/mol for fluoride. (Author's abstract) W90-06616

OPTIMIZATION OF A TWO-PHASE ANAERO-BIC DIGESTION SYSTEM TREATING A COMPLEX WASTEWATER.
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
G. Dinopoulou, and J. N. Lester.
Environmental Technology Letters ETLEDB, Vol. 10, No. 9, p 799-814, September 1989. 3 fig, 7

Descriptors: *Acidogenic bacteria, *Anaerobic di-gestion, *Biological wastewater treatment, *Meth-ane bacteria, *Wastewater treatment, Biomass, Chemical oxygen demand, Efficiency, Fluidized bed process, Pollution load.

Physical separation of acidogenic and methano-genic bacteria allows for maximization of the rates of acidification and methanogenesis by application of optimal operational conditions. This results in better process control and increased stability of the anaerobic digestion surface. The acid of the control of the contro better process control and increased stability of the anaerobic digestion system. The performance of such a system, consisting of a continuous-flow stirred tank acidogenic reactor and a methanogenic fluidised bed reactor was assessed for different ratios of the hydraulic retention times of the two ratios of the hydraulic releation times of the two reactors. Different influent substrate concentra-tions and organic loading rates were also applied. The results show that this two-phase system is capable of chemical oxygen demand removals superior or similar to a single-stage system, when the volume of the methanogenic reactor is reduced by volume of the methanogenic reactor is reduced by up to 25% and an equal volume of acidogenic reactor is introduced. The optimum volume of 12 to 25 ppt of the overall active volume, which during the present study allowed for a hydraulic retention time in the range of 1.7 to 6.8 h. The reduction of the methanogenic reactor by as much as 25 ppt in a two-phase system results in considerable reduction of the investment cost of the most acceptable reduction of the investment cost of the most expressive sizes of engineers (the fluidized bad aoir reduction of the investment cost of the most expensive pieces of equipment (the fluidized bed reactor and the recycle pumps) and decreased operating costs. Further savings are also achieved due to the improved quality of the biogas evolved. (Brunone-PTT) W90-06622

EFFECT OF PH ON SULFIDE TOXICITY TO ANAEROBIC PROCESSES.
Manitoba Univ., Winnipeg. Dept. of Civil Engi-

J. A. Oleszklewicz, T. Marstaller, and D. M.

McCartney. Environmental Technology Letters ETLEDB, Vol. 10, No. 9, p 815-822, September 1989. 6 fig, 2

Descriptors: *Anaerobic digestion, *Hydrogen ion concentration, *Sulfides, *Toxicity, *Wastewater treatment, Acetates, Biodegradation, Biological wastewater treatment, Butyrates, Lactate, Propio-

Anaerobic treatment processes applied to sludge and industrial wastewater often suffer from toxicity of sulfide generated by sulfate reducing bacteria. Effects of sulfide on anaerobic degradation of lactate, butyrate, propionate (Pr) and acetate (Ac) were studied in batch serum bottles. Maintenance of a higher pH = 7.7-7.9 allowed for the tolerance of a much higher concentration of sulfide, pointing to un-ionized hydrogen sulfide as the inhibitory sulfide species. Concentration thresholds of 50% inhibition by total and un-ionized sulfide were determined. Lactate utilization was the least affected while propionate degradation was the least affected while propionate degradation was the most affected by sulfide. Data analysis using semi-log graphs of substrate utilization rates vs. sulfide produced of substrate utilization rates vs. sulfide, produced retardation coefficients (k) of 0.6 L/mg for acetate

and 1.2 L/mg for propionate. Retardation was more pronounced in a mixed Ac/Pr run than in pure Ac and Pr runs. These retardation coefficients will have practical implications for process control as traditionally, methanogenesis form acetate is the main control/monitoring parameter. (Author's abstract)

SIMULTANEOUS REMOVAL OF OIL AND HEAVY METALS FROM INDUSTRIAL WASTEWATERS USING HYDROXIDE OR SULFIDE PRECIPITATION COUPLED WITH AIR FLOTATION.

Argonne National Lab., IL. Energy Systems Div.

R. W. Peters, and G. F. Bennett.
Hazardous Waste and Hazardous Materials
HWHME2, Vol. 6, No. 4, p 327-345, Fall 1989. 8
fig, 2 tab, 30 ref.

Descriptors: *Air flotation, *Bases, *Chemical pre-cipitation, *Heavy metals, *Industrial wastewater, *Oil, *Sulfides, *Wastewater treatment, Chemical treatment, Copper, Lead, Zinc

A combined chemical-precipitation/air-flotation system was studied to simultaneously remove system was student to simultaneously remove heavy metals and oil from a synthetic wastewater typically containing 25 mg/liter each of copper, lead, and zinc, plus 1000 mg/liter of oil. The wastewaters were subjected to hydroxide or sulfide treatment and collectors simultaneously with air flotation. The precipitants were mixed rapidly introduction for 2 mixed follows: into solution for 2 minutes, followed by a flotation time of 4 minute. The effects of various collectors and their dosages, as well as the type of precipi-tant, were examined in terms of removals of oils and heavy metals. Five different chemical collecand heavy metals. Five different chemical collectors were investigated: sodium lauryl sulfate (NaLS), Atlasep 2A2, Nalco-7182, Nalco-7734, and TFI. 365. Applied collector dosages ranged from 0-1442 mg/liter. Removals of heavy metals and oils of at least 93.85% can be attained using this innovative technology. The residual concentrations are sensitive functions of pH, collector type and dosage, precipitant type, and air-injection rate. The presence of oil had little, if any, effect on the removal of copper and lead by sulfide precipitation, while the removal of zinc decreased by shout 38% due to the presence of oil. No single shout 38% due to the presence of oil. No single tation, while the removal or zinc decreased by about 38% due to the presence of oil. No single chemical collector or precipitant type provided the optimal removal of all constituents studied (copper, lead, zinc, and oil). By proper choice of precipitant type and collector dosage, reduced metal concentrations lower than 0.2 mg/liter can easily be obtained using the combined chemical-precipitation/air-flotation technology. (Author's abstract) W90-06627

DEGRADATION OF DIGESTED SEWAGE SLUDGE IN MARINE SEDIMENT-WATER MODEL SYSTEMS, AND FATE OF METALS. Essex Univ., Colchester (England). Dept. of Biol-

ogy.
D. B. Nedwell, and P. A. Lawson.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No.
2, p 87-91, February 1990. 2 fig, 3 tab, 16 ref.

Descriptors: *Biodegradation, *Digested sludge, *Fate of pollutants, *Marine sediments, *Mineral-ization, *Peth of pollutants, *Sludge disposal, *Wastewater disposal, Load distribution, Model

Cores of marine sediment were used in model systems to examine degradation of digested sewage sludge in the marine environment at the sedimentwater interface. Models of both accumulative and water interface. Models of both accumulative and dispersive sites were used, at sludge loadings greater than those applied at sea disposal sites. Mineralization to carbon dioxide was measured using an infra-red gas analyzer, and the proportionate mineralization of the added organics increased as loading rate decreased. About 60% of the added organics increased in the contractive of the cont ic carbon was mineralized at the lowest rate applied 0.01 kg solids/sq m/day over the 133 days of the experiment. Metals added to the systems in the sludge (zinc, lead) were immobilized by the sedi-ment and not exported from the model. These

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results indicate that the organic component of di-gested sewage sludge discharged into a shallow water marine environment, such as the North Sea, is likely to be rapidly mineralized at the sediment-water interface. This is particularly so where the hydrography of the site tends to disperse the sludge, and reduce the relative load upon the environment. In contrast, metals associated with the sludge are immobilized and accumulate in the sediments when the organic fraction is mineralized by microbial activity. (Author's abstract) W90L06646

WASTEWATER EFFLUENT VS. SAFETY IN ITS REUSE: STATE-OF-THE-ART.

Jordan Univ. of Science and Technology, Irbid. A. B. M. Shahalam.

Journal of Environmental Sciences JEVSAG, Vol. 32, No. 5, p 35-42, September/October 1989. 12 tab, 67 ref.

Descriptors: *Agriculture, *Disinfection, *Public health, *Reviews, *Wastewater irrigation, *Wastewater treatment, *Water quality, *Water

The subject of wastewater reuse has been a controversial subject during the last few decades due to the fear of harmful effects on human health and the environment. Recent technology relating to wastewater treatment methods has changed the wastewater treatment methods has changed the outlook significantly. This article presents a state-of-the-art review of the available data on wastewater treatment performance, particularly relating to the removal of pathogenic agents. The areas specifically covered are: wastewater quality from various wastewater systems with respect to pathogens; available conventional and nonconven-tional wastewater treatment technologies; available laboratory methodologies for enumerating the pathogenic state of wastewater and their reliabilipathogenic state of wastewater and their reliabilities; various methodologies of preuse disinfection of wastewater and their feasibility for practical use; and the pathogen survival rates in liquid water and various other media. The human health risks associated with wastewater reuse in agriculture are assessed at the present level of understanding, and areas that need further investigations are delineated. (Author's abstract)

SCREENING AT MARINE OUTFALL HEAD-

D. K. Thomas, S. J. Brown, and D. W.

D. N. 1100mas, 3, 3, 20, 100m.

Journal of the Institution of Water Engineers and Scientists JUWSDI, Vol. 3, No. 6, p 533-547, December 1989. 12 fig, 3 tab, 23 ref.

Descriptors: *Municipal wastewater, *Outfall sewers, *Screens, *Tidewater, *Wastewater disposal, *Water pollution control, *Water quality, Recreation.

The UK approach to pollution control in tidal waters places considerable emphasis on balancing the contrasting needs of utilization of the waters for the assimilation of effluents with the protection of all identified uses, i.e., the Environmental Quality Objective/Environmental Quality Objective/Environmental Quality Standard (EQO/EQS) approach. In order to protect uses of the waters for bathing and general amenity, this approach in the design of improvement schemes necessary for marine sewage discharges is examined through the protection of the p ined. However, recent guidelines for consent appli-cations dealing with schemes designed to protect bathing use suggest a departure from the EQO/ baning use suggest a departure from the EQO, EQS approach towards an emission standard when dealing with the solid phase of the sewage effluent. The implications of these approaches are discusses from the design (scientific and engineering) viewfrom the design (scientific and engineering) view-points. A summary of headworks processes and the current practice for preliminary treatment at marine outfall sites in the UK is reviewed, together with comments on their effectiveness. The terms of reference and work of a joint working group to examine the efficiency of screening equipment at marine outfall headworks is described, together with a technical summary of results collected at a range of sites and with various types of equipment. Recommendations for future research are given,

and a strategy for screening is developed. (Author's abstract) W90-06711

SEDIMENTS IN SEWERS. Water Research Centre, Swindon (England). Pollution Managem R. W. Crabtree. Management Group.

Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 569-578, December 1989. 4 fig, 5 tab, 22 ref.

Descriptors: *Combined sewer overflows, *Sediment transport, *Sediments, *Silt, England, Storm wastewater, Water pollution sources.

A recent survey has suggested that up to 25,000 km of UK sewage networks may be affected by inpipe sediment deposits. Field evidence indicates that, typically, up to 90% of the pollution load discharges from the storm sewage overflows may be derived from the erosion of accumulated in system sediment, commonly referred to as silt. A sewer flow quality simulation model is being developed under the aegis of the WRc/Water Industry Collaborative River Basin Management research program. Such a model will enable sewer-age engineers and water quality planners to age testimeter and war quanty panners produce more effective designs for sewerage rehabilitation schemes to control river pollution. In order to produce this model it is necessary to understand the nature, characteristics and controlling mechanisms of in-pipe sediment deposits. Field observations, coupled with sampling and analysis of combined sever sediment deposits, have produced a five category classification for such sediments. Each category has distinctive characteristics in terms of appearance, composition and pollution potential. (Author's abstract)

OPERATIONAL EXPERIENCES WITH PACKAGE FILTER SEWAGE-TREATMENT PLANTS.

A. E. Stoodley.

Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 583-587, December 1989. 4 fig, 5 tab.

Descriptors: *Biological wastewater treatment, *Operating costs, *Wastewater facilities. *Operating costs, *Wastewater *Wastewater treatment, Package plants

Package filter plants', in which biological filtration and secondary settlement occur in a single enclosed unit, are mechanically simple, relatively cheap to install, have low odor, minimal site requirements, and in theory require little maintenance. However, experience so far has shown that there are several problem areas: (a) effluent quality there are several problem areas: (a) effluent quality has been too variable to be considered satisfactory; (b) secondary sludge return pumps may be oversized on smaller units; (c) the overall standard of construction could be improved, probably with minimal additional cost; (d) certain problems are not easy to diagnose, due to poor access to controls and enclosed design; (e) early information on operating costs shown that smaller package filter plants are inferior to rotating biological contactor of similar size; however, larger units should comof similar size; however, larger units should com-pare more favorably. This type of package plant is becoming more common, many being privately owned and maintained. Performance data for most owned and maintained. Performance data for most plants will be scant, but there is no doubt that some will not be performing satisfactorily. Before there is more widespread adoption by water authorities, it may be necessary to undertake full-scale evaluations of the process. This would require the modification of an existing site to allow comprehensive sampling, monitoring and flow measurement, or construction of a site with these in mind. In conjunction with such an appraisal, there should be cooperation with the manufacturers, not only to confirm the optimum design criteria, but to improve construction standards. (Author's abstract) W90-06718

LAND-TREATMENT SYSTEMS: DESIGN AND PERFORMANCE WITH SPECIAL REFERENCE TO REED BEDS.
C. D. Bayes, D. H. Bache, and R. A. Dickson.

Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 588-598, De-cember 1989. 5 fig, 8 tab, 14 ref.

Descriptors: *Artificial wetland treatment, *Land disposal, *Wastewater treatment, Biological oxygen demand, Hydraulic conductivity, Pilot

The principles of design of a land treatment system are explained on the basis of determining the land area requirements of particular constituents in area requirements of particular constituents in terms of the supply rate and assimilative capacity. Illustrative data are provided for the design and performance of slow-rate and overland flow sys-tems. A comprehensive report on the design and performance of pilot studies carried out on a reed-bed treatment system at Valleyfield, Fife, Scotland, provides valuable insight into the choice of the bed substrate and the problems of reed establishment. Of the media tested, coarse pulverized fuel ash appeared to be promising in terms of its hydraulic appeared to be promising in terms of its hydraulic conductivity and reduction in biochemical oxygen demand (BOD). For a domestic sewage of typical demand (BOD). For a domestic sewage of typical strength, a bed area of 5 sq m per population equivalent yielded an effluent having a BOD of less than 20 mg/L, but did not provide conditions which were conducive to significant nitrogen re-moval. (Author's abstract) W90-06719

COMPARISON OF DISINFECTION TECHNIQUES FOR SEWAGE AND SEWAGE EFFLUENTS.

Consultants Environmental Sciences Ltd. London (England).
T. Rudd, and L. M. Hopkinson.

Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 612-618, December 1989. 1 fig, 3 tab, 21 ref.

*Reviews, Descriptors: *Disinfection, *Wastewater treatment, Bromine chloride, Chlora-mines, Chlorination, Chlorine, Chlorine dioxide, Gamma radiation, Hypochlorite, Lime, Peracetic acid, Toxicity, Ultraviolet radiation.

This paper reviews operational and experimental disinfection techniques for the removal of patho-gens from sewage and secondary effluent prior to marine discharge, and their environmental impact. gens from sewage and secondary effluent prior to marine discharge, and their environmental impact. Disinfection options considered include chlorine (hypochlorite, chloramines, on-site electrolytic chlorination), UV light, ozone, chlorine dioxide, bromine chloride, peracetic acid (PAA), gamma irradiation, and lime treatment in the form of the Clariflow process. Important considerations in the choice of a disinfectant include the size of the installation, the nature of the effluent, and the effluent discharge requirement. If economic considerations prevail, chlorine compounds (especially hypochlorite) are attractive. Seasonal application and dechlorination to preclude residual toxicity could be used to reduce environmental impact. Ozone and UV require effluent of at least secondary quality to be feasible both economically and technically. However, these appear to have a minimal environmental impact. If economic aspects are not overriding and minimal environmental impact is important, the Clariflow process could have not overriding and minimal environmental impact is important, the Clariflow process could have application. Of the experimental disinfectants, chlorine dioxide merits further investigation as a wastewater disinfectant. Although about three times more expensive than gaseous chlorine, it is associated with a lower degree of by-product for-mation. PAA is a flexible alternative for all sewage types, suitable for emergency use. However, it is less effective for more resistant microorganisms and has high operating costs. Bromine chloride produces a lower residual toxicity than chlorine although hominated by-products may be equally produces a lower residual toxicity than chlorine although brominated by-products may be equally as toxic as the analogous chlorine products. Ionizing radiation is an effective disinfection process for a range of microorganisms, but its high cost and the perceived hazards associated with it are likely to mitigate against its adoption. (Sand-PTT) W90-06722

REPORT FROM MALAWI, AFRICA. For primary bibliographic entry see Field 5F.

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W90-06723

3H-THYMIDINE INCORPORATION: PRELIMINARY INVESTIGATIONS OF A METHOD TO FORECAST THE TOXICITY OF CHEMICALS IN BIODEGRADABILITY TESTS.

Vandkvalitetsinstitutet, Hoersholm (Denmark). For primary bibliographic entry see Field 5C. W90-06760

EFFECT OF SLUDGE TREATMENT ON THE ORGANIC CONTAMINANT CONTENT OF SEWAGE SLUDGES.

SEWAGE SLUDGES. Lancaster Univ. (England). Inst. of Environmental and Biological Sciences. S. R. Wild, and K. C. Jones. Chemosphere CMSHAF, Vol. 19, No. 10/11, p 1765-1777, 1989. 4 fig, 28 ref.

Descriptors: *Organic pollutants, *Path of pollutants, *Sludge disposal, *Sludge thickening, *Sludge treatment, Adsorption, Aromatic compounds, Benzenes, Chlorinated hydrocarbons, Dewatering, Organic compounds, Organic wastes, Polychlorinated biphenyls, Volatile organic compounds, Organic wastes, Polychlorinated biphenyls, Volatile organic com-

During the treatment of sewage sludge before disposal, there is the potential for some organic pol-lutants present in the sludge to be lost through volatilization, biological degradation, abiotic/ chemical degradation and extraction with excess liquors. These losses would seem to be important for the more volatile organics rather than the for the more votatile organics rather than the hydrophobic, lipophilic non-volatiles. However, there is lack of evidence that the volatile aromatics (benzene, toluene, xylene, dichlorobenzene) are lost during sludge treatment processes. One possible explanation for this is stabilization of volatile ble explanation for this is stabilization of volatile organics by adsorption onto sludge particles. During sludge thickening, priority pollutants may accumulate in liquors or be lost through volatilization. Disinfection by heating at high temperatures may also cause volatilization of organic pollutants. Stabilization by anaerobic or aerobic digestion can increase the concentrations of some organic pollutants while reducing the concentrations of others. Losses of organics by degradation is the most desirable method of reduction making the sludge more amenable to land disposal as long as leachabimore amenable to land disposal as long as leachability is not increased. During incineration, if high nty is not increased. During incineration, if high enough temperatures are not reached, organic chemicals may be converted rather than destroyed and can therefore escape to the atmosphere via fly ash or volatilization. Methods of organic pollutant destruction and removal in sewage sludges require more research and quantification. (Geiger-PTT) W90-06771

CAPILLARY SUCTION THEORY FOR RECTANGULAR CELLS.
Houston Univ., TX. Dept. of Chemical Engineer-

ing. F. M. Tiller, Y. L. Shen, and A. Adin. Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 130-136, March/April 1990. 8 fig, 12 ref. DOE Grant No. DE-FG05-87ER13786.

Descriptors: *Capillarity, *Mathematical models, *Sludge drying, *Wastewater treatment, Darcys

A new model of the capillary suction apparatus A new model of the capitary suction apparatus with a rectangular reservoir is presented. Parallel flow paths emanating from the reservoir lead to one-dimensional Cartesian coordinate geometry. The filter paper is cut in rectangular sheets parallel to the grain to avoid the anisotropic effects inherto the grain to avoid the anisotropic effects inherently present in capillary suction procedures which depend on radial flow. Development of a mathematical model relating distance travelled by the liquid front to time permits calculation of the average specific resistance. The conventional filtration formula for the cake formed in the reservoir combined with the Darcy equation as applied to the paper yields a differential equation involving the rate of advance (dx/dt) of the front and the distance (x) travelled by the front. Integration leads to a parabolic relation between x and t. Linear

plots are used to obtain the average specific resistance. (Author's abstract) W90-06836

CHARACTERISTICS OF NOSTOCOIDA LIMI-COLA AND ITS ACTIVITY IN ACTIVATED SLUDGE SUSPENSION. Environmental Services, Edmonton (Alberta). G. Nowak, and G. D. Brown. Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 137-142, March/April 1990. 5 fig, 2 tab, 18 ref.

Descriptors: *Activated sludge, *Anoxic condi-tions, *Filamentous bacteria, *Wastewater treat-ment, Microorganisms, Nostocoida.

The filamentous microorganism, Nostocoida limi-cola, was investigated in pure culture and full-scale studies to determine nutritional requirements and growth factors. In pure culture, N. limicola repro-duced very well in aerobic and anaerobic condi-tions on a variety of carbohydrates if peptone was tions on a variety of caroonydrates in perione was present in the media. In activated sludge its occurrence was associated with the conditions of low organic loading and extended mean cell residence time. Growth of N. limicola can be controlled successfully in activated sludge systems by means of an anoxic selector or reduced sludge age. (Author chartest programme of the conditions of th thor's abstract) W90-06837

CAUSES AND CONTROL OF NOCARDIA IN ACTIVATED SLUDGE,
California Univ., Berkeley. Dept. of Civil Engi-

P Pitt and D Jenkins Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 143-150, March/April 1990. 6 fig, 7 tab, 20 ref.

Descriptors: *Activated sludge, *Anoxic conditions, *Filamentous bacteria, *Wastewater treatment, Foaming, Microorganisms, Nocardia, Process control, San Francisco.

Nocardia foaming is a serious problem in activated studge affecting 66 ppt of surveyed U.S. activated studge plants. The main strategy for Nocardia control was mean cell residence time (MCRT) reduction to under 6 days. A counting technique to assess Nocardia levels in activated studge was deassess Nocardia levels in activated studge was de-veloped. Bench-scale experiments showed that No-cardia amarae growth was both MCRT and tem-perature dependent. Bench-scale anaerobic selector experiments were successful in reducing Nocardia levels in one of four tests. Full-scale anaerobic selector experiments at the city and county of San Francisco Southeast plant showed reduced Nocardia levels in an anaerobic selector system compared to a control system. (Author's abstract) W90-06838

PERFORMANCE AND DESIGN OF A SELECTOR FOR BULKING CONTROL.
Vanderbilt Univ., Nashville, TN. Dept. of Environmental and Water Resources Engineering.
J. Patoczka, and W. W. Eckenfelder.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 151-159, March/April 1990. 11 fig, 3 tab, 22 ref.

Descriptors: *Bulking sludge, *Continuous flow reactors, *Filamentous bacteria, *Wastewater treatment, Flocculation, Microorganisms, Recy-

Experimental data was obtained from continuous-flow reactors over a wide range of selector organic loadings, contact times, and floc loadings. These were correlated using a semiempirical equation with the selector's organic loading as the inde-pendent variable. Data previously quoted in the literature were also correlated using this relation-ship. Based on the proposed model for the reaction rate in the selector a model for optimizing a selec-tor's performance for bulking control is proposed. The model balances two conflicting requirements for successful floc-former selection: high substrate concentration in the selector and high substrate

removal efficiency in the selector. Experimental data on seven continuous-flow reactors supports the model assumptions. Where the selector's volume is set by physical and/or economical convolume is set oby physical and/or economical constraints, the optimum sludge recycle rate for bulking control was a function of a single system constant. The optimum sludge recycle rate is always less than 100 ppt. (Author's abstract) W00,06830

COMPARISON OF ACTIVATED SLUDGE STA-BILIZATION UNDER AEROBIC OR ANOXIC

Maryland Univ., College Park. Dept. of Civil En-

M. H. Kim, and O. J. Hao.

Research Journal of the Water Pollution Control
Federation JWPFA5, Vol. 62, No. 2, p 160-168,
March/April 1990. 15 fig, 5 tab, 22 ref.

Descriptors: *Activated sludge, *Aerobic conditions, *Anoxic conditions, *Sludge stabilization, *Wastewater treatment, Ammonium, Nitrates.

The feasibility of anoxic sludge digestion, along with controlled aerobic digestion is evaluated in this study. In the endogenous nitrate respiration system, nitrate instead of oxygen is utilized as the terminal electron acceptor for the microorganisms involved in biomass destruction under anoxic conditions. The results indicated that the anoxic cell deep rate was a first order reaction with restrict on the conditions. ditions. The results indicated that the anoxic cell decay rate was a first-order reaction with respect to volatile suspended solids (VSS), but with a decreasing rate. The nitrate requirement was approximately 0.54 mg nitrate-nitrogen/mg VSS destruction. The digester pH was almost three units higher than that of the aerobic digester (pH 8.5 versus 5.5). After 10 days of anoxic digestion, the VSS description the district of the control of VSS destroyed and 0.12 mg ammonium generation was 2000 mg/L, 1.8 mg calcium carbonate/mg VSS destroyed, and 0.12 mg ammonia-nitrogen/mg VSS destroyed, respectively. The ma-introgen/mg vss destroyed, respectively. Ine digester supernatant contains a large quantity of colloidal particles (between 0.45 and 1.2 microns) which cause poor sludge dewaterability. These fine particles also contain high concentrations of organic nitrogen resulting in a high amount of organic natter recycling back to the plant. The practical application of the use of the anoxic sludge is discussed. (Author's abstract) W90-06840

NITRIFICATION AND PHOSPHORUS PRE-CIPITATION WITH BIOLOGICAL AERATED FILTERS

Anjou Recherche, Maisons-Laffitte (France). Anjou Recherche, Maisons-Lamite (France).

R. Rogalla, M. Payraudeau, G. Bacquet, M.-M.

Bourbigot, and J. Sibony.

Research Journal of the Water Pollution Control

Federation JWPFA5, Vol. 62, No. 2, p 169-176,

March/April 1990. 13 fig, 8 tab, 30 ref.

Descriptors: *Activated sludge, *Biofilm reactors, *Nitrification, *Phosphorus removal, *Sludge stabilization, *Wastewater treatment, Biological fil-

The biological aerated filter is an innovative tech nology that combines aerobic degradation of pol-lutants and physical retention of suspended matter intants and physical retention of suspended matter in one reactor. A high concentration of active biomass can be achieved in the packed bed reactor, and nitrifying bacteria can be retained on the filter media, allowing ammonia oxidation independently of sludge age. The options of phosphorus and nitrogen removal with biological aerated filters were explored with semi-industrial pilot plants. Phosphorus was precipitated with iron salts in lamella settlers before aerated biofilter treatment. The efficiency of settling and biological treatment was related to hydraulic and operational param-eters. Nitrification can be achieved by reducing the carbonaceous load on the biofilter. The limits of loading were verified to obtain a final effluent todam were verified to obtain a min efficient quality of around 1 mg/L each of phosphate-P and ammonia-N, and 10 mg/L each of biological oxygen demand and suspended solids. The results of a full-scale nitrifying biofilter and of a highly loaded aerated biofilter plant with seasonal pollution variations are present. Since the first demonstration of the property of tion variations are present. Since the first de

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stration plant was built 10 years ago, about 15 fullscale BAF plants have been taken into service or are under construction in France, ranging in population equivalents from 20,000 to 200,000. About 30 nation equivalents from 20,000 to 200,000. About 30 smaller plants are operating in Japan for private use such as industry or building recycle. A demonstration study is under way to confirm the applicability of the process for Japanese public sewage systems. (Author's abstract)

REDUCTION IN BACTERIAL DENSITIES OF WASTEWATER SOLIDS BY THREE SECOND-ARY TREATMENT PROCESSES.

ARY IRRAIMENT PROCESSES.
Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
J. B. Farrell, B. V. Salotto, and A. D. Venosa.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 177-184, March/April 1990. 5 fig. 7 tab, 10 ref.

Descriptors: *Activated sludge, *Fecal coliforms, *Wastewater treatment, Bioindicators, Recirculation, Salmonella.

Some wastewater treatment plants have no pri-mary clarifiers but recirculate the sludge within the system for long periods. Reduction of Salmo-nella sp. and fecal indicator bacteria densities in the sludge particles was investigated and compared with reduction of these densities in conventional primary settling and activated sludge treatment. Bacterial densities in the suspended solids in the Bacterial densities in the suspended solids in the entering wastewater were compared with densities in the waste sludge. Reductions in Salmonella sp. densities (number/gram) in the sludge were about 0.5 log greater for the five no-primary long-sludgeage plants than for the conventional plant. Similar differences were found for fecal indicator densities. Fecal indicator densities based on suspended solids content of the wastewater were nearly the same for all six plants. Since reductions were consistent for all plants, it appears possible to estimate per-formance of a treatment plant for reducing bacte-rial densities in sludge solids only by examining the final raw sludge product. (Author's abstract) W90-06842

SIMPLIFIED DESIGN OF BIOFILM PROCESSES USING NORMALIZED LOADING CURVES.

Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
M. S. Heath, S. A. Wirtel, and B. E. Rittmann.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 185-192, March/April 1990. 8 fig, 3 tab, 15 ref.

Descriptors: *Biofilm reactors, *Design criteria, *Wastewater treatment, Sludge treatment, Steady

A simple, yet fundamentally based design procedure was developed for steady-state biofilm processes. Based on families of normalized loading curves, the design method maintains the rigor of mechanistic biofilm models, but it allows simple and rapid computation of required design volume for biofilm reactors. The use of the normalized for biofilm reactors. The use of the normalized loading curves also allows the engineer to obtain an intuitive understanding of the response of the process to changes in loading. For example, low loaded processes can withstand large changes in surface loading with only small changes in steady-state effluent concentration, while the effluent concentration from highly loaded processes exhibits high sensitivity to changes in surface loading. (Author's obtract) thor's abstract)

BIOLOGICALLY ENHANCED OXYGEN TRANSFER IN THE ACTIVATED SLUDGE PROCESS.

PROCESS.
Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.
J. S. Mueller, and H. D. Stensel.
Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 193-203, March/April 1990. 14 fig, 3 tab, 29 ref.

Descriptors: *Activated sludge, *Oxygen transfer, *Wastewater treatment, Aeration, Biological *Wastewater treatment, oxygen demand.

Biologically enhanced oxygen transfer has been a hypothesis to explain observed oxygen transfer rates in activated sludge systems that were well rates in activated studge systems that were well above that predicted from aerator clean-water testing. The enhanced oxygen transfer rates were based on tests using BOD bottle oxygen uptake rates (OURs) on samples removed from the activated sludge system. Bench-scale and full-scale vated studies were performed to compare results of in situ OUR measurement techniques to BOD bottle OUR measurements. The studies showed that the condition of low dissolved oxygen (DO) that the condition of low dissolved oxygen (DO) and high OUR for which the greatest enhanced oxygen transfer was reported resulted in OURs in the BOD bottle tests well above the actual in situ OURs. For high DO and high OUR activated sludge operating conditions, the BOD bottle OURs were below the actual in situ OURs. The BOD bottle OUR values accurately described in situ OURs for endogenous respiration conditions with nonlimiting DO concentrations. These results suggest that previously observed biologically enhanced oxygen transfer was not actually occurring but was the result of the BOD bottle test method and activated sludge operating condition. (Auand activated sludge operating condition. (Author's abstract) W90-06844

SOME LIPOPHILIC COMPOUNDS FORMED IN THE CHLORINATION OF PULP LIGNIN

AND HUMIC ACIDS.
Svenska Traeforskningsinstitutet, Stockholm.
For primary bibliographic entry see Field 5B.
W90-06916

SUPERFUND RECORD OF DECISION: LUDLOW SAND AND GRAVEL, NY. Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field 5G. W90-06953

CHARACTERIZATION AND TREATMENT OF BY-PRODUCT WATERS FROM SELECTED OIL SHALE RETORTING TESTS.
University of Wyoming Research Corp., Laramie. Western Research Inst.
J. S. Nordin, R. Poulson, N. Niss, and C. Laya. Available from the National Technical Information Service, Springfield, VA. 22161, as DE89-000914. Price codes: A04 in paper copy, A01 in microfiche. Topical Report No. DOE/MC/11076-2638, December 1987. 78p. 4 fig. 12 tab, 10 ref, 2 append. DOE Contract DE-FC21-86MC11076.

Descriptors: *Oil industry, *Oil shale, *Oil wastes, *Pollutant identification, *Wastewater treatment, Bicarbonates, Dissolved solids, Organic carbon, Organic compounds, Oxidation, Phenols, Pyri-

Oil shale retorting by-product waters from four surface retorting pilot tests and three simulated modified in situ retorting pilot tests were charac-terized for inorganic and organic chemical con-stituents. Eastern and western United States shales were retorted for the tests. Ammonium bicarbon-ate, ammonium thiosulfate, various pyridines, and ate, ammonium thiosulfate, various pyridines, and phenolic species were among the principal contaminants in the retort by-product water. The water also contains total dissolved solids up to 7,000 parts per million (ppm). When steam was used as a source of heat for oil shale retorting, the condensate that formed diluted the concentrations of contaminants, especially mineral dissolved solids, in the by-product water. The combined water treatment steps of hot-gas stripping followed water treatment steps of hot-gas stripping followed by wet air oxidation at 600 F and 2,000 pounds per square inch (psi) for 30 minutes removed 99% of the total organic carbon in the retort by-product water, producing a colorless and almost odor-free water. In one treatment test, the total organic carbon (TOC) was reduced from 3,400 mg/L to < 20 mg/L, with the 20 mg/L TOC remaining consisting of low molecular weight carboxylic acids. Only a partial TOC reduction occurred, with various alkylpyridines remaining as residuals when the retort waters were subjected to wet air oxidation as the only treatment step. Electrocoagulation as an initial water treatment step removed < 30% of the TOC. (Lantz-PTT) W90-06956

SECONDARY TREATMENT: VARIATIONS EX-M. Choudhury

Water Engineering and Management WENMD2, Vol. 137, No. 2, p 18-20, February 1990. 4 ref.

Descriptors: *Biological wastewater treatment, *Secondary wastewater treatment, *Wastewater treatment, Activated sludge process, Aerobic digestion, Anaerobic digestion, Oxidation ponds, Trickling filters.

The secondary biological wastewater treatr process varies from plant to plant and with different effluent standards. More than 90% of the conent effluent standards. More than 90% of the contaminants are removed at this stage. Aerobic, anaerobic, and combinations of the two may be selected for this main process. The size and type of treatment units considered are based on such parameters as amount and condition of influent, available acreage, desired effluent characteristics, and budget. The trickling filter, activated sludge, oxidation pond, and variations of these are the more commonly used systems in which organic matter is broken down by the metabolic activity of naturally occurring microorganisms. Trickling filters are a form of fixed or attached growth biological process. Variations of this method include the rotating biological contactor, submerged biological contactor, and the fluidized bed reactor. In activated sludge treatment, wastewater from the primary settling tank is vigorously aerated so inherent bacsludge treatment, wastewater from the primary settling tank is vigorously aerated so inherent bacteria can work on the organic mass. Modifications of this method include the Anaerobic/Oxic or system, and multistage biological reactors. Oxidation ponds are an example of the anaerobic process which depends on the oxygen present in and generated by the reactions in the wastewater to grow microorganisms that feed on organic matter. (Agostine-PTT) won_06005 W90-06995

SIMPLE APPROACH TO DECHLORINATION. Flood Engineers, Jacksonville, FL.

J. A. Hefty. Water Engineering and Management WENMD2, Vol. 137, No. 2, p 25-27 February 1990. 1 fig, 2 ref.

Descriptors: *Biological wastewater treatment, *Dechlorination, *Florida, *Secondary wastewater treatment, -Wastewater treatment, Dehalogenation, Effluents, Water quality standards.

The city of Fort Myers, Florida operates two biological nutrient-removal wastewater treatment facilities. After the plants were constructed in 1985, the effluent contained chlorine residual concentrations of approximately 0.5 mg/L total chlo-rine. In 1986 the Environmental Protection Agency placed the city under an administrative order to reduce its wastewater-treatment-plant-eforder to reduce its wastewater-treatment-plant-effuent concentration to no greater than 0.01 mg/L total chlorine residual. The cost for modifications and tankage for both plants was estimated at \$3.2 million. The city decided that a less costly alternative was needed. The solution was to incorporate a new process within the confines of existing facilities. Instead of traditional chlorine contact tanks, ties. Instead of traditional chlorine contact tanks, sulfur-dioxide-mix tanks, and post-aeration equipment, the system uses the plant outfall pipelines as the chlorine-contact chambers. The sulfur-dioxide solution is injected through diffusers into plant effluent conveyed through the outfall. The sulfur-dioxide dosage is adjusted in response to flow and the chlorine residual signal. The system was placed into operation in July 1988. In July 1989 the city certified the successful operation of these unique facilities. (Agostine-PTI) facilities. (Agostine-PTT) W90-06997

PROGRESSIVE PROCESS CONTROL

Waste Treatment Processes—Group 5D

Jefferson Parish Dept. of Sewerage, Harahan, LA. D. P. Butler, J. H. Beall, and J. G. Dipre. Water Engineering and Management WENMD2, Vol. 137, No. 2, p 30-32, February 1990. 3 fig.

Descriptors: *Automation, *Control systems, *Process control, *Wastewater facilities, *Wastewater treatment, Louisiana, Mississippi River, Secondary wastewater treatment, Suspend-

The East Bank Wastewater Treatment Plant of Jefferson Parish in Harahan, LA, combines traditional secondary wastewater treatment with advanced distributed process control. Instrumentation for the distributed data acquisition and process control system is based on multiple microprocessors. The distributed controls system consists of three major components; multiprocessor controller. three major components: multiprocessor controller files with input/output modules (field mounted), operator stations with color-remote-terminal monitors and keyboards, and a fiber-optic cable commu-nication system. The new East Bank plant consolinication system. The new East Bank plant consolidates waste from seven old wastewater treatment plants on four sites, managing the treatment needs of 275,000 people. Designed for secondary treatment, the wastewater plant must reduce both biochemical oxygen demand and total suspended solids in the discharge to 30 pm on a monthly average. The plant discharges into the Mississippi River. (Agostine-PTT) W90-06998

IMPACT OF THE GREENHOUSE EFFECT ON SEWERAGE SYSTEMS: LUND CASE STUDY. Lund Univ. (Sweden). Dept. of Water Resources For primary bibliographic entry see Field 5C. W90-07023

LEVELS OF HEAVY METALS AND ORGAN-OCHLORINE PESTICIDES OF CYPRINID FISH REARED FOUR YEARS IN A WASTEWATER TREATMENT POND. 'Adour-Garonne' Water Authority, 90 rue du Fer-etra, 31078 Toulouse, France.

For primary bibliographic entry see Field 5B. W90-07035

TOXICITY AND ACCUMULATION OF CHROMIUM IN CERATOPHYLLUM DEMERSUM L. MIUM IN CENATOFITI LUM LEMENSOM L. National Botanical Research Inst., Lucknow (India). Aquatic Botany Lab. P. Garg, and P. Chandra. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 44, No. 3, p 473-478, March 1990. 1 fig. 4 tab, 16 ref.

Descriptors: *Bioaccumulation, *Biological treatment, *Chromium, *Submerged plants, *Toxicity, *Wastewater treatment, *Water pollution treatment, Biomass, Chlorophyll, Heavy metals, Plant

Several aquatic plants have been seen to be effective in biological water treatment systems to improve water quality, but not much information is available on chromium (Cr) uptake by aquatic vascular plants. Ceratophyllum demersum, a submerged aquatic plant, was used because of its common occurrence and luxuriant growth in a polluted water body which contained 0.05 to 0.25 ppm Cr. Young shoots of C. Demersum were cultured for 8 weeks, before being exposed to 0.05, 0.05, 0.1, 1 and 2 ppm Cr for up to 168 hours (7 days). No significant change in biomass was observed in the lower concentrations of Cr. However, decrease in biomass was observed at 1 and 2 observed in the lower concentrations of cr. frow-ever, decrease in biomass was observed at 1 and 2 ppm after 48 hours. Cr uptake at each concentra-tion was high within 48 hours with 75.22, 117.70, 160.87, 216.32, and 576.98 micrograms/g dry weight at 0.005, 0.05, 0.1, 1, and 2 ppm Cr, respectively. However, the uptake rate was comparative-ly low during the next 120 hours in all concentraty low during the next 120 nours in air concentra-tions. Both chlorophyll content and carotenoids decreased at all Cr concentrations. It is concluded that 0.1 ppm Cr is the safe limit for C. demersum and that the plant could be an effective material for the abatement of Cr pollution in the aquatic envi-ronment. (VerNooy-PTT)

W90-07037

W90-07052

REMOVAL OF SOME HEAVY METALS BY

Delaware Univ., Newark. Dept. of Civil Engineer-For primary bibliographic entry see Field 2K.

ASSESSING MICROBIAL TOXICITY OF 2-ETHOXYETHANOL AND BIS(2-CHLOR-ETHOXYETHANOL AND BIS(2-CHLOR-OETHYL) ETHER BY A MODIFIED SPREAD

PLATE METHOD.

PLATE METHOD.
Texas Univ. Health Science Center at Houston.
School of Public Health.
Y. H. Cho, E. M. Davis, and G. D. Ramey.
Environmental Technology Letters ETLEDB,
Vol. 10, No. 10, p 875-886, October 1989. 5 fig. 4

criptors: *Alcohols, *Bacterial analysis, hers, *Toxicity, *Wastewater analysis, stewater treatment, Antagonistic effects, Bio-cal wastewater treatment, Culturing tech-*Wastewater treatm niques, Industrial wastewater, Laboratory methods, Model studies, Performance evaluation, Stabilization ponds, Synergistic effects.

Spread plate count techniques were used to assess individual and combined toxicity of bis(2-chloroethyl) ether and 2-ethoxyethanol to heterotrophic bacterial populations. Samples of industrial wastewater influent to a series of three stabilization wastewater influent to a series of three stabilization ponds were used on plates where the chemicals were added to the agar. The counts of the colonies formed after incubation at 35 C for 48 hours showed increased growth inhibition with increased chemical concentrations. Bis(2-chloroethy) ether was the more toxic chemical, although neither was extremely toxic. A multiplicative survival model was used to show that the two compounds acted without synergism or antagonism. Wastewater treatment facilities beade on because il degreeated was used to show that the two compounds access
without synergism or antagonism. Wastewater
treatment facilities based on bacterial degradation
could use this technique to evaluate spill level
tolerance of treatment systems. (Miller-PTT)
W90-07053

BEHAVIOUR OF NITRILOTRIACETIC ACID DURING UPFLOW SLUDGE BLANKET CLAR-IFICATION.

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab. M. Hunter, T. Stephenson, R. Perry, and J. N.

Environmental Technology Letters ETLEDB, Vol. 10, No. 12, p 1027-1040, December 1989. 5 fig, 4 tab, 38 ref.

Descriptors: *Chelating agents, *Nitrilotriacetic acid, *Sludge, *Wastewater treatment, Detergents, Heavy metals, Pilot plants, Wastewater.

The removal of nitrilotriacetic acid (NTA), a synthetic detergent builder, was investigated in a pilot-scale upflow sludge blanket clarification process. Initial studies involved dosing influent water with 1 mg/L and 2.5 mg/L NTA for 32 and 34 d respectively at a surface load of 0.55 m/h. NTA removals during these periods were 62.6 % and 41.9% respectively. At a surface loading of 1.82 m/h when the influent NTA was 2.5 mg/L, NTA removal decreased to 26.4%. A transient increase in influent NTA concentrations from 2.5 to 5.0 mg/L resulted in significant reduction in NTA removal. A combined transient increase in NTA concentration and surface loading caused a substantial decrease in NTA removal. The heavy metals chromium, iron, manganese, and nickel were unaffected by the presence of NTA during steady state operation. However, during the transient increase in influent NTA, a significant decrease in nickel removal occurred. (Author's abstract) The removal of nitrilotriacetic acid (NTA), a synstract) W90-07056

EFFECTS OF SLUDGE RECYCLE RATIO ON NITRIFICATION-DENITRIFICATION PERFORMANCE IN BIOLOGICAL TREATMENT OF LEACHATE.

British Columbia Univ., Vancouver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W90-07057

INNOVATIVE CONTRACT OPERATIONS AGREEMENTS.

Professional Services Group, Inc., Houston, TX. Water Engineering and Management WENMD2, Vol. 137, No. 1, p 26-27, January 1990.

Descriptors: *Contracts, *Facilities management, *Wastewater facilities, *Water treatment facilities, Costs, Financing, Maintenance, Privatization.

Funding for capital improvements to existing systems obtained through innovative contract operations and maintenance agreements can provide a cost-effective alternative to public financing. Privately operated and maintained municipal water and wastewater facilities have increased by over 300 percent in the past 5 years. The private firm provides the municipality with the funding needed to expand plant capacity, improve treatment efficiency, lower costs, and improve safety conditions. Some firms operate many plants and purchase supciency, lower costs, and improve safety conditions. Some firms operate many plants and purchase supplies for less through national contracts. Prepayment of future savings allows the municipality to expand or upgrade the facility. Long-term contract operator may benefit by investing their own money in capital improvements. When determining if contract operations is viable, the primary objective should be improved plant efficiency, compliance with regulatory standards, long-term preventive maintenance, and lower costs. (Miller-PTT) W90-07061

NEW TREATMENT SCHEMES CONTROL ODORS.

McIlvaine Co., Northbrook, IL. B. McIlvaine.

Water Engineering and Management WENMD2, Vol. 137, No. 1, p 28-31, January 1990.

Descriptors: *Air pollution control, *Biological wastewater treatment, *Chemical treatment, *Odor control, *Organoleptic properties, Filtration, Incineration, Public relations, Scrubbing.

Treatment of odors involves the processes of Treatment of odors involves the processes of chemical treatment, fume incineration, wet scrubbing, adsorption, and biofiltration. Addition of chemicals can be effective for odors at the headworks, trickling filters, sludge dewatering, and sludge storage. Odorous molecules can be incinerated by either catalytic or high temperature incineration. The most effective and economical method of odor control to date is wet scrubbing. method of odor control to date is wet scrubbing. The packed tower is the most commonly used scrubber design. Scrubbers that recirculate the scrubbing liquid optimize use of the oxidizing chemical. Liquid-phase catalytic oxidation followed by adsorption is a new method of odor control. Chemical adsorption uses activated carbon, or other media, treated to be chemically reactive with the vapors. Odor control technology today faces the critical issues of standardization and accurate odor measurement. In the new and accurate odor measurement. In the new method of biological scrubbing, odors are transmethod of biological scrubbing, odors are trans-ferred to a liquid which undergoes microbial treat-ment. Biofilters and bioscrubbers avoid the draw-back of transferring the problem to another phase of the treatment. Municipalities are finding a need for substantial investment in odor control technology to avoid citizen complaints and law suits. (Miller-PTT) W90-07062

1990 GUIDE FOR TREATING HYDROGEN SULFIDE IN CEWERS.
HDR Engineering, Inc., Denver, CO.
J. D. Chwirka, and T. T. Satchell.
Water Engineering and Management WENMD2,
Vol. 137, No. 1, p 32-35, January 1990. 2 fig.

Descriptors: *Hydrogen sulfide, *Odor control, *Sewer gas, *Sewer systems, Absorption, Activated carbon, Adsorption, Chlorine, Ventilation.

Group 5D—Waste Treatment Processes

Hydrogen sulfide is generally treated by adsorption, holding the hydrogen sulfide onto a porous material, or absorption, mass transfer into a scrubing solution. These systems can be separate or combined. Activated carbon for adsorption must eventually be replaced or regenerated through a caustic wash. Regeneration is limited to three or four times and can take 5 to 15 days to complete. Prediction of hydrogen sulfide generation is important to scrubber design. The two basic types of absorption systems are packed towers and mist systems. The chemistry of scrubbing solutions varies with the type of scrubber. Chlorine solution combined with caustic soda will oxidize the discombined with caustic soda will oxidize the dis-solved sulfide to sulfates and control pH. Chlorine solution by itself is acidic and causes undesirable chlorine gas to be released. Sodium hypochlorite chlorine gas to be released. Sodium hypochlorite or hydrogen peroxide in solution with caustic sodia is also used. A fan pulling foul air from the sewer will create a negative pressure condition which will draw fresh air into the sewer. The natural ventilation rate is used as a basis for designing forced ventilation systems. Air discharged from a treatment system must be sufficiently dispersed to prevent detection. Dilution by adding a second fan and increased stack height can accomplish this. (Miller-PTT) W96-07063

NEW TECHNOLOGIES HELP HOUSTON IN-

SPECT ITS SEWERS.
Houston Dept. of Public Works, TX.
H. N. Gregory, and C. A. Hansen.
Public Works PUWOAH, Vol. 121, No. 2, p 58-60, February 1990. 2 fig.

Descriptors: *Computers, *Data collections, *Houston, *Mastewater treatment, Compliance, Measuring instruments, Texas.

In order to comply with a Texas Water Commis-In order to comply with a lexas Water Commission and Environmental Agency Region VI administrative order to inspect its wastewater system over the next two years, Houston is adapting a variety of new technologies to help streamline field-to-office data collection and meet mandated reporting milestones. The Wasteload Control Branch (WCB) of the Houston Department of Public Wester established seeds for the houston. Public Works established goals for the management of the inspection: to provide an efficient means to issue cleaning and inspection work to outside contractors; to establish city-wide field inoutside contractors, to establish city-wide held in-spection, cleaning rating, defect, and street ad-dressing standards; to maintain data integrity and accuracy of all field inspection data; to provide a system that multiple users could access; to ensure timely review of physical inspection data; to comtimely review of physical appection dais; to com-pare actual versus planned compliance targets; and to identify, sort by priority, and recommend needed repair, rehabilitation, and replacement projects. The city uses handheld computers to projects. The city uses handheld computers to collect data, laptop computers with pop-up windows to the city's defect standards, picture capture management systems, and a rules-based expert system to assimilate the inspection results and to determine repair strategies. This combination of new technologies has allowed Houston to manage its physical inspection project and to develop an early warning system for the wastewater system. (Brunone-PTT)
W90-07105

CHARACTERIZATION OF THE ORGANIC COMPONENT OF A SLUDGE. Universita degli Studi 'La Sapienza', Rome (Italy). Diet di Chesica Chesica (Italy).

Dipt. di Chemica.

B. M. Petronio, T. Ferri, C. Papalini, and A.

Diccolo.

Talanta TLNTA2, Vol. 36, No. 12, p 1177-1182,
December 1989. 4 fig, 3 tab, 37 ref.

Descriptors: *Chemical analysis, *Differential thermal analysis, *Sludge, *Sludge analysis, *Spectrometry, *Wastewater treatment, Fractionation, Industrial sludge, Italy, Municipal sludge, Organic

Two sludges of different origin were characterized by fractionating the organic content into five parts (by using acids and bases), followed by multipletechnique examination of each fraction. The sludge samples were obtained from an urban wastewater treatment plant in East Rome (Italy) and from the production waste treatment process of a brewery near Messina Sicily. The techniques used included chemical analysis, thermal analysis, infrared spectrometry and 13C-NMR spectrometry. The convenient fractionation and the combined use of chemical and physical methods seemed to provide chemical and physical methods seemed to provide the only way of showing both structural and com-positional differences in such complex matrices. The fractionation lad to a simplification of the matrix that was indispensable for revealing the presence of components that otherwise could not easily be identified. The results emphasize that it is easily be identified. The results emphasize that it is not possible to disprove the presence of certain functional groups by means of spectroscopic data alone, nor in all cases to interpret signals quantita-tively. Besides the characterization of the sample and the differentiation of samples from different origins, the method suggested is extremely useful for studying the changes that the organic substances in the sludge undergo with time. (Mertz-PTT) W90-07184

REVIEW OF THE ROLE OF THE PHYSICO. CHEMICAL ENVIRONMENT IN THE PRO-DUCTION OF CERTAIN FLOC PROPERTIES. Kansas State Univ., Manhattan. Dept. of Chemical Engineering.

For primary bibliographic entry see Field 5F. W90-07224

EFFECT OF ELODEA DENSA ON AQUACUL-

TURE WATER QUALITY.
National Univ. of Singapore. Dept. of Civil Engineering.
W. J. Ng, T. S. Sim, S. L. Ong, K. Kho, and L. M.

Aquaculture AQCLAL, Vol. 84, No. 3/4, p 267-276, February 1990. 5 fig, 2 tab, 9 ref.

Descriptors: *Aquiculture, *Elodea, *Land treat-ment, *Vegetation effects, *Wastewater treatment, *Water quality control, *Water reuse, Ammonium, Aquatic plants, Nitrates, Nitrites, Nitrogen remov-al, Turbidity.

The effect of Elodea densa on aquaculture water quality in a 11.40 cu m tank was examined. A total of 15 water quality parameters was monitored over a period of 4 months. Hourly samples were collected and analyzed to determine the variation in water quality within an 8-h working day. The aquatic plant tank removed 61.36 mg nitrate nitrogen/sq m/day, 2.27 mg nitrite nitrogen/sq m/day and 9.09 mg ammonia nitrogen/sq m/day. Overall nitrogen removal was 25% of influent nitrogen concentration. The plant tank also reduced turbidity effectively. Harvesting the plants for sale did not severely affect the tank's performance except for the 3-4 days following a harvest. The results suggested that E. densa was an efficient plant for nitrogen removal, and fish and plant production might be combined to allow for water renovation and reuse on an aquaculture farm. (Author's ab-The effect of Elodea densa on aquaculture water and reuse on an aquaculture farm. (Author's abstract) W90-07225

PILOT-SCALE EVALUATION OF AEROBIC-ANOXIC SLUDGE DIGESTION.
Vancouver (British Columbia).
C. C. Peddie, and D. S. Mavinic.
Canadian Journal of Civil Engineering CJCEB8,
Vol. 17, No. 1, p 68-78, February 1990. 12 fig, 3
tab, 11 ref.

Descriptors: *Aerobic digestion, *Pilot plants, *Sludge digestion, *Wastewater treatment, Acti-vated sludge process, Aerobic treatment, Liming, Oxidation-reduction potential, Settleable solids,

A pilot-scale (300 L) evaluation of waste activated sludge digestion by a cyclical aerobic-anoxic mode of operation was undertaken at ambient liquid temperatures (14-17 C). Three experimental runs were conducted over a 2-year period. The first run compared the aerobic-anoxic process to a conven-

tional, continuously aerated, digestion process. During the second run, the aerobic-anoxic digester was compared to a lime-supplemented convention-al aerobic process. The third run compared two aerobic-anoxic digester units, operating at reduced (50 and 25% of normal) aeration rates during the aerobic period. Results from the various experimental runs indicated numerous potential advantages for the aerobic-anoxic mode of digester operations. tages for the aerobic-anoxic mode of digester operation. The main advantage was that turning the air on and off resulted in volatile solids reduction efficiencies similar to that in the continuously aerated systems. The aerobic-anoxic operating mode was capable of conserving most of the influent alkalinity and maintaining near-neutral pH conditions over prolonged periods of operation. Similar results were achieved using a range of aeration rates during the aerobic phase. These results indicate that a significant savings in aeration costs might be realized without a loss in solids destruction efficiency. However, it should be noted that tion efficiency. However, it should be noted that air diffusers are more susceptible to clogging during the anoxic period owing to settlement of solids. In addition to the potential for significant solids. In addition to the potential for significant savings in aeration costs, another benefit of the intermittent aeration mode of operation involved improved supernatant quality of the final, settled effluent. The lime-supplemented operation also resulted in improved supernatant quality, with 100% nitrification efficiency, and lower phosphorus levels owing to chemical precipitation. Oxidation-reduction potential is a useful and promising parameter for the monitoring and possible control of aerobic-anoxic systems. (Author's abstract) W90-07236 W90-07236

EXAMINATION OF THE EFFECT OF WASTEWATER ON THE PRODUCTIVITY OF LAKE ZURICH WATER USING INDIGENOUS PHYTOPLANKTON BATCH CULTURE BIOLOGY VS BIOASSAYS.

Zurich Univ., Kilchberg (Swizerland). Hydrobio-logical-Limnological Station. For primary bibliographic entry see Field 5C. W90-07269

EXTRACTING HEAVY METALS FROM MU-NICIPAL AND INDUSTRIAL SLUDGES. National Taiwan Univ., Taipei. Inst. of Environ-

mental Engieering. K. S. L. Lo, and Y. H. Chen.

Science of the Total Environment STENDL, Vol. 90, p 99-116, January 1990. 12 fig, 10 tab, 17 ref. National Science Council (Republic of China) Contract NSC 73-0410-E002-06.

Descriptors: *Heavy metals, *Sludge treatment, *Wastewater treatment, Acids, Cadmium, Chelating agents, Chromium, Cost analysis, Industrial wastes, Lead, Metal removal, Municipal wastes, Nickel, Performance evaluation, Zinc.

(H2SO4), ethylenediaminetetras (EDTA), and nitrilotriacetatic acid (NTA) treat-ment were used to explore the removal efficiencies ment were used to explore the removal efficiencies of heavy metals from municipal and industrial sludges. The results indicate that the optimum treatment efficiencies of heavy metal extraction from sludge are related to the species of heavy metals in sludge, the dosage of extractants, and the reaction time. The removal efficiency of a three-stage countercurrent process was higher than those of single-stage processes. When the heavy metals in the sludge contact and react with the extracting agent, the removal ratio increases with increasing time. Thus, the removal rate is proportional to the time. Thus, the removal rate is proportional to the concentration of the remaining metal. The cost of concentration of the remaining metal. The cost of the acid treatment process per unit weight of heavy metal extracted was lowest when heavy metal concentrations were high, but the EDTA process was least expensive with low heavy metal concentrations. For municipal sludges, the NTA treatment appropriate for removing Cd and Ni, the acid process was best for removing Zn and Cr, and the EDTA method provided the highest removal of Pb. For industrial sludges, the acidity process gave the highest removal of Cd, Cr, Ni, and Zn, and the EDTA treatment was best for Pb. (Rochester-PTT)

Waste Treatment Processes—Group 5D

STABILITY OF ACTIVATED SLUDGE REACTORS WITH SUBSTRATE INHIBITION KINETICS AND SOLIDS RECYCLE.

Padua Univ. (Italy). Ist. di Impianti Chimici.

A. Bertucco, P. Volpe, H. E. Klei, T. F. Anderson, and D. W. Sundstrom.

and D. W. Sundstrom. Water Research WATRAG, Vol. 24, No. 2, p 169-176, February 1990. 10 fig, 21 ref.

Descriptors: *Activated sludge process, *Sludge solids, *Wastewater treatment, Hysteresis, Kinetics, Mixing, Simulation analysis, Stirred tank reactors.

The steady-state simulation of activated sludge reactors with settler and recycle of the concentrated biomass was considered for the case of substrate inhibition kinetics. Analytical relationships were developed for the continuous stirred tank reactor; numerical simulation was performed for other reactors. Occurrence of multiple solutions and hysteresis behavior were examined as a function of fresh feed residence, recycle ration, recycle solids concentrations, and sludge age. Four main conclusions can be derived. The first one is that special care should be taken about the possibility of kinetic effects due to substrate inhibition and to the health term, since the calculated steady-states of the system may deviate considerably from the common Monod-like ones. As a second point, the occurrence of washout has to be considered as an actual danger. A third conclusion is related to the hysteresis effects: the dramatic changes of the overall substrate conversion occurring upon small perturbations of the system variables around their steady-state values are not reversible. Finally, depending on mixing is the fact that the situation in any point within the reactor can be changed from a low to a high conversion one. Therefore, both the design and the operation of activated sludge reactors for toxic waste could take advantage of the capability of simulating their performances as a function of the inlet substrate and biomass concentration and the process variables, that is: spacetime, recycle ratio, biomass recycle concentration (or, preferably, sludge age), kind of reactor configuration and degree of internal mixing. (Author's abstract)

AZOLLA PINNATA R.BR. AND LEMNA MINOR L. FOR REMOVAL OF LEAD AND ZINC FROM POLLUTED WATER.

Indian Inst. of Tech., New Delhi. Centre for Rural Development and Appropriate Technology. For primary bibliographic entry see Field 5G. W90-07418

METHANOGENIC DEGRADATION OF OZON-ATION PRODUCTS OF BIOREFRACTORY OR TOXIC AROMATIC COMPOUNDS.

Kentucky Univ., Lexington. Dept. of Civil Engineering. Y.-T. Wang.

Water Research WATRAG, Vol. 24, No. 2, p 185-190, February 1990. 7 fig, 5 tab, 13 ref.

Descriptors: *Anaerobic digestion, *Aromatic compounds, *Ozonation, *Toxicity, *Wastewater treatment, Hydrogen ion concentration, Ozonation products.

The anaerobic biodegradability and inhibition potential of ozonation products of four biorefractory aromatic compounds (o-cresol, benzenesulfonic acid, 2,5-dichlorophenol and 2,4-dinitrophenol) were evaluated in this study. The ozonation products of all four compounds tested were biodegradable to methane and the biodegradability improved with increasing dose of ozone. Early ozonation products of o-cresol and benzenesulfonic acid were more inhibitory than the initial compounds while ozonation reduced the toxicity of 2,5-dichlorophenol and 2,4-dinitrophenol. Ozonation products formed in the basic pH range were more biodegradable and were less inhibitory than those formed in the acid pH range under the same dose of ozone. (Author's abstract)

STIMULATION OF PSYCHROPHILIC METH-ANATION WITH A SEPTIC TANK BIOLOGI-CAL ACTIVATOR (STIMULATION DE LA METHANISATION PSYCHROPHILE PAR UN BIOACTIVATEUR POUR FOSSE SEPTIQUE), Montpellier-1 Univ. (France). Lab. d'Hydrologie et d'Hygiene.

stompenets of Hygins and A. Rambaud.

S. Maunoir, H. Philip, and A. Rambaud.

Water Research WATRAG, Vol. 24, No. 2, p 195-205, February 1990. 4 fig, 7 tab, 35 ref. English summary.

Descriptors: *Anaerobic digestion, *Domestic wastes, *Methanogenesis, *Septic tanks, *Wastewater treatment, Acetate methanation, Blogas, Chemical oxygen demand, Hydrogen ion concentration, Microparticles, Volatile acids.

Septic tanks ensure the pretreatment of domestic wastewater by fulfilling two functions: settling of solid matter and liquefaction of the sludges by anaerobic digestion. Various commercial products are known to improve anaerobic digestion of sludges. The effects of an industrial product composed only of argiliaceous microparticles (kaolinite, at a concentration of 4 g/L) on the methanation of acetic acid (2 g/L) were studied. The first preliminary assay of acetate methanation was run at 35 C. It showed the typical evolution of batch volatile-acids degradation-decrease in chemical oxygen demand (COD), increase in pH, and biogas production, in addition, it showed the influence of the microparticles since in 11 days the maximum biodegradation rate was about 87%, versus about 26% in the control. The second preliminary assay, at 20 C, showed that the endogenic digestion of the inoculum does not interfere with results and confirmed the stimulating effect of microparticles than for controls. Gas production showed also that the microparticles reduce the time of latency. In a third test, three bioassays with three different inocula were conducted simultaneously to evaluate the reproducibility of the methanogenesis and its stimulation in these experimental conditions. A fourth test was run in order to have a statistical validation of the stimulation; it was ashown that the variability in results is mainly due to septic tank sludge sampling variability and that the methanation measurements are reliable. It is concluded that argillaceous microparticles stimulate batch biomethanation of acetic acid at 20 C. This effect is on the reduced time of latency and on the degradation rates. (Shidler-PTT)

FIXED-BIOFILM REACTORS IN AQUACUL-TURAL WATER RECYCLE SYSTEMS: EFFECT OF ORGANIC MATTER ELIMINATION ON NITRIFICATION KINETICS.

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control. J. Bovendeur, A. B. Zwaga, B. G. J. Lobee, and J.

Water Research WATRAG, Vol. 24, No. 2, p 207-213, February 1990. 6 fig, 1 tab, 14 ref.

Descriptors: *Aquaculture, *Biofilms, *Nitrification, *Organic wastes, *Wastewater treatment, *Waster reuse, Chemical oxygen demand, Oxidation.

A special biofilm adaptation system and a biofilm monitoring system were developed for use in recycling water for aquaculture. The good agreement of biofilm performance between artificial aquaculture samples and samples taken from an operative trickling filter showed that the methods used are suitable tools for research on fixed-biofilm processes. Research focused on the effect of simultaneous removal of organic matter on the zero-order biofilm airtification rate in relation to the production of fecal organic matter. The biofilm removed organic matter at rates directly proportional to the COD (chemical oxygen demand) loading rate, showing efficiencies around 85%. Biofilm respiration experiments showed that only a small fraction (about 10%) of the COD removed has actually been oxidized simultaneously. The oxygen consumption was only 0.065 g oxygen/g COD. The corresponding reduction factor for the simultaneous nitrification process was -0.015 g/sq m/d am-

monia nitrogen nitrified per g/sq m/d COD removed. The reduction of the nitrification rate by simultaneous COD oxidation indicates that under the applied conditions the nitrification process has been limited by the transfer of oxygen into the biofilm layer. (Author's abstract) W90-07422

SUSPENDED SOLIDS IN BIOLOGICAL FILTER EFFLUENTS.

Toronto Univ. (Ontario). Dept. of Civil Engineering.

mg.
W. M. Zahid, and J. J. Ganczarczyk.
Water Research WATRAG, Vol. 24, No. 2, p 215-220, February 1990.8 fig. 2 tab. 13 ref.

Descriptors: *Biological filters, *Suspended solids, *Trickling filters, *Wastewater treatment, Multiexposure photographic technique, Particle size, Settling velocity.

Some physical properties of suspended solids in two trickling filter effluents were measured. Several size indices and shape factors of these particles were determined with the use of an image analysis system. The applicability of the sample preservation technique limited the studied particles to those with the longest dimension greater than 10 microm. The majority of the particles studied had diameters of less than 100 microm. The settling velocities and the sizes of the particles studied were measured in a quiescent water column by a multiexposure photographic technique. Results showed that particle settling velocity increased as a fractional power of size. Based on these direct measurements, the particle density was calculated, and found to decrease with an increase of the particle size. (Author's abstract)

BIOTECHNOLOGICAL SULPHIDE REMOV-AL IN THREE POLYURETHANE CARRIER REACTORS: STIRRED REACTOR, BIOROTOR REACTOR AND UPFLOW REACTOR.

Agricultural Univ., Wageningen (Netherlands).
Dept. of Water Pollution Control.
C. J. Buisman, B. Wit, and G. Lettinga.
Water Research WATRAG, Vol. 24, No. 2, p 245-251, February 1990. 9 fig, 2 tab, 15 ref.

Descriptors: *Sulfide removal, *Sulfur, reactors, *Wastewater reactors, Dissolved oxygen, Mixed tank reactor, Sludge, Sulfate production, Upflow reactor.

Three reactor systems were compared in order to assess their suitability for a new biotechnological sulfide removal process. This process is based on the conversion of sulfide to sulfur. The sulfide removal rates under conditions where the sulfide effluent concentration did not exceed 2 mg/L was for the CSTR (completely mixed tank reactor), biorotor and upflow reactors 2.4, 10, 11 kg S/cu m/day, respectively. The differences in volumetric sulfide load in these cases mainly depend on the different sludge concentrations. When using Rasschig rings (rings with a cylindrical shape, diameter of 5 cm, height of 3 cm and total surface of 180 sq cm) instead of PUR (recticulated polyurethane) particles the capacity for the biorotor system decreased to 5.0 kg S/cu m/day. The applicable hydraulic retention times at a sulfide influent concentrations below 2 mg/L were for the CSTR, biorotor and upflow reactors 35, 10 and 13 min, respectively. Under identical operational conditions the sulfate production in the biorotor and upstream reactors remains lower than in the CSTR. The sulfate production rate in the biorotor can be controlled by changing the oxygen concentration in the gasphase and in the other two reactor systems by changing the dissolved oxygen concentration. (Author's abstract)

BIOREMEDIATION OF CHLOROPHENOL CONTAINING SIMULATED GROUND WATER BY IMMOBILIZED BACTERIA.

Group 5D—Waste Treatment Processes

Alko Ltd., Helsinki (Finland). For primary bibliographic entry see Field 5G. W90-07429

GAS EXCHANGE THROUGH THE SOIL-AT-MOSPHERE INTERPHASE AND THROUGH DEAD CULMS OF PHRAGMITES AUSTRALIS IN A CONSTRUCTED REED BED RECEIVING DOMESTIC SEWAGE.

Aarhus Univ. (Denmark). Botanical Inst.

Water Research WATRAG, Vol. 24, No. 2, p 259-266, February 1990. 5 fig, 2 tab, 25 ref.

Descriptors: *Aerobic digestion, *Anaerobic digestion, *Artificial wetland treatment, *Decomposing organic matter, *Land treatment, *Reeds, *Wastewater treatment, *Wetlands, Gas exchange, Hydraulic conductivity, Nitrogen, Phosphorus,

The decomposition processes of organic matter during winter in a 3-year old soil-based constructed reed bed with lateral sub-surface water flow were evaluated by quantifying the influx and efflux of metabolic gases and by considering input-output budgets and relating these to storages within the bed. The total flux of gaseous oxygen into the bed was 5.86 g/sq m/day of which 2.08 g/sq m/day was through the cavities of dead, still standing culms of Phragmites australis. The respiratory oxygen consumption of the roots and rhizomes almost perfectly balanced the oxygen influx through the culms leaving only 0.02 g oxygen/sq m/day to be released to the surrounding soil. The macrophyte-induced rhizosphere oxygenation was therefore of no quantitative importance for aerobic BOD degradation and microbial nitrification. Organic matter was degraded aerobically by means of BOD degradation and microbial nitrification. Organic matter was degraded aerobically by means of oxygen delivered directly from the atmosphere and anaerobically by methanogenic bacteria in the upper layers of the soil. Some nitrogen and phosphorus was retained with sludge deposition on the surface of the bed and in the inlet trench. The constructed reed bed under study did not function according to the theory of the root-zone process. The majority of the wastewater moved along preferred pathways on the surface of the bed because of low soil hydraulic conductivity. Changes in the physical design and the operational practice of constructed reed beds are needed to improve and optimize performance efficiency for nutrients. (Author's abstract) thor's abstract) W90-07430

TREATED WASTEWATERS AS A GROWING WATER RESOURCE FOR AGRICULTURE USE

King Saud Univ., Riyadh (Saudi Arabia). Dept. of Chemical Engineering. For primary bibliographic entry see Field 3C. W90-07432

CARRIER-GAS PROCESS—A NEW DESALINA-TION AND CONCENTRATION TECHNOLO-

EvCon Corp., Minneapolis, MN. For primary bibliographic entry see Field 3A. W90-07439

BEST DEMONSTRATED AVAILABLE TECH-NOLOGY (BDAT) FOR POLLUTION CON-TROL AND WASTE TREATMENT (APR 75 -

National Technical Information Service, Springfield, VA

Iteld, VA. Available from the National Technical Information Service, Springfield, VA. 22161, as PB90-857202. Price codes: N01 in paper copy, N01 in microfiche. Report NZ 8770, January 1990. 104p.

Descriptors: *Bibliographies, *Waste treatment, *Water pollution control, *Water pollution treat-ment, Best demonstrated available technology,

This bibliography contains citations concerning the most current equipment and processes for pollution control and waste treatment that attempt to meet

the guidelines set by the Environmental Protection Agency (EPA). Technology for pollution control and waste treatment used by the EPA to develop and waste treatment used by the EPA to develop current effluent standards, and pollution control methods used by industry to meet those standards are considered. Standards for gaseous, liquid, and solid pollution are discussed. BDAT (best demon-strated available technology as defined by the EPA. This updated bibliography contains 221 citations from the NTIS bibliographic database, 22 of which are new entries to the previous edition. (Authors abstract) (Authors abstract) W90-07472

WASTEWATER TREATMENT (DEC 87 - JUL

National Technical Information Service, Spring-field, VA.

neta, v A. Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-868046. Price codes: NOI in paper copy, NOI in microfiche. Report NZ6205, August 1989. 38p.

Descriptors: *Bibliographies, *Wastewater treatment, Heavy metals, Hydrocarbons, Industrial wastewater, Oil wastes, Wastewater renovation.

This bibliography contains citations concerning techniques and equipment for the treatment of industrial (except mining) effluent streams. Consideration is given to the removal, reclamation, and recycling of various trace metals, heavy-metals, hydrocarbons, and oily wastewaters to meet regulatory agency discharge or inplant reuse standards. This updated bibliography contains 85 citations, from the COMPENDEX database, all of which have new extricts to the receiving edition. (Author's representations) are new entries to the previous edition. (Author's abstract) W90-07473

5E, Ultimate Disposal Of Wastes

DETERMINATION OF THE IGNITION TEMPERATURES OF SEWAGE SLUDGE.

Clemson Univ., SC. Dept. of Environmental Systems Engineering.

S. Schwarz, T. J. Overcamp, and T. M. Keinath Environmental Technology Letters ETLEDB, Vol. 10, No. 7, p 621-632, July 1989. 1 fig. 1 tab, 7 ref. Argonne National Lab. Contract 41182401 and DOE Contract W-31-109-Erg-38.

Descriptors: *Incineration, *Sludge disposal, *Sludge drying, *Sludge treatment, *Waste disposal, *Wastewater treatment, Temperature.

Drying sludges before incineration renders the process more energy-efficient, but may also increase the potential for self-ignition and combustion of dried sludge in the dryer, in the sludge handling equipment, and/or during sludge storage. At present, no recognized method exists to determine the ignitability of sludges. In this paper, a method to determine the flash-ignition and self-ignition temperatures of dried sewage sludge is described. A hot-air furnace, similar to that used in ASTM Standard D 1929, was used to test two municipal and two industrial sludges. The flash-ignition temperatures ranged from 344 C to 432 C, and the self-ignition temperatures ranged from 439 C to 481 C. These ignition temperatures may be useful in assessing the potential of sludge combustion in dryers or in storage. (Brunone-PTT) W90-06613

POLLUTION OF HARBOUR SEDIMENTS BY HEAVY METALS.

Antwerpse Waterwerken (Belgium). For primary bibliographic entry see Field 5G. W90-06687

SCREENING AT MARINE OUTFALL HEAD-

For primary bibliographic entry see Field 5D. W90-06711

EFFECT OF NATURAL LIGANDS ON TRACE METAL PARTITIONING.

Water Research Centre, Medmenham (England). For primary bibliographic entry see Field 5B. W90-06754

MODELING FRACTURE FLOW WITH A STO-CHASTIC DISCRETE FRACTURE NETWORK: CALIBRATION AND VALIDATION: 1. THE FLOW MODEL

Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). For primary bibliographic entry see Field 2F.

MODELING FRACTURE FLOW WITH A STO-CHASTIC DISCRETE FRACTURE NETWORK: CALIBRATION AND VALIDATION: 2. THE TRANSPORT MODEL.

Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France).
For primary bibliographic entry see Field 2F.

SUPERFUND RECORD OF DECISION: NATIONAL STARCH, NC.

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. For primary bibliographic entry see Field 5G. W90-06954

EFFECT OF APPLICATIONS OF SEWAGE SLUDGE ON N, P, K, CA, MG AND TRACE ELEMENTS CONTENTS OF PLANT TISSUES. Institut National de la Recherche Scientifique,

Sainte-Foy (Quebec). D. Couillard, and Y. Grenier.

W90-06858

Science of the Total Environment STENDL, Vol. 80, No. 2/3, p 113-125, May 1989. 6 tab, 31 ref. NSERC Grant A-3711.

Descriptors: *Digested sludge, *Fertilizers, *Plant growth, *Plant tissues, *Sludge utilization, *Trace elements, Cations, Tamarack.

A four-month study was conducted in a green-house with Larix laricina (Tamarack) grown in sand and nursery soil. This culture was fertilized with anaerobically digested sludge at various rates and doses. No direct relationship could be estab-lished between the growth of seedlings and the quantities of sludge applied. Relationships were, however, established between the quantities of sludge applied and the elemental composition of the tissues. There was a significant, positive corre-lation between the growth of seedlings and the phosphorus and nitrogen content of their tissues. phosphorus and nitrogen content of their tissues. Furthermore, there was a significant positive correlation between the concentrations of these elements in the different parts of the seedlings studied and the quantities of sludge added. However, the sludge did not provide sufficient K to improve the nutrient status of the sand. This anomaly could have been corrected by adding mineral K in the form of a chemical fertilizer. In the case of Ca, Mg and the trace elements, their elevated concentrations in the sludge resulted in adequate or excessive tions in the sludge resulted in adequate or excessive concentrations in the seedlings. Finally, since the differences between treatments were not sufficientuniferences between treatments were not sufficiently important, it was not possible to determine if burying the sludge was better than surface fertilization. This question could have been answered if a longer experiment had been carried out. (Chonka-W90-06974

TALL FESCUE GROWTH IN GREENHOUSE, GROWTH CHAMBER, AND FIELD PLOTS AMENDED WITH SEWAGE SLUDGE COMPOST AND FERTILIZER.

Agricultural Research Service, Beltsville, MD. Soil-Microbial System Lab.

C. F. Tester.

Soil Science SOSCAK, Vol. 148, No. 6, p 452-458, December 1989. 2 fig, 6 tab, 10 ref.

Ultimate Disposal Of Wastes-Group 5E

Descriptors: *Composting, *Fertilization, *Fescues, *Field tests, *Greenhouses, *Growth chambers, *Regression analysis, *Sludge utilization, Nitrogen, Y eld.

Recommendations for using sewage sludge compost to satisfy the nitrogen requirements of crops, which resulted from greenhouse and controlled environmental growth chambers studies, have not been sufficiently validated with field trials. Studies were conducted to evaluate the effects of sewage sludge compost and complete fertilizer amendments on yields and nitrogen content of 'Kentucky 31' tall fescue (Festuca arundinacea Schreb.) grown on Evesboro loamy sand (mesic, coated Typic Quartzipsamments) in different environments. Compost was applied at rates of either 0, 45, 90, or 135 Mg/ha in greenhouse and growth chamber pot studies and 0, 60 120, and 240 Mg/ha in field trials. Fertilizer (N, P, K) was applied at 0 and 200 kg/ha where indicated. Compost amendment increased the yields of fescue linearly in all three growth environments. For the second crop, yields were 50% of those for the first crop in the field. A conservative estimate for compost N utilization by the fescue crop was 8% for the initial cropping season and 5% for the second season (determined from the entire plant uptake in the greenhouse and growth chamber). These estimates may be low because the average utilization of compost N by the tall fescue in the field plots was 7% for the first year clippings alone (roots and stubble not analyzed). Equivalent dry matter yields were obtained for the 135 Mg/ha compost amendment and complete fertilizer for greenhouse grown fescue; however, equivalent yields for the fieldgrown fescue were realized by the 60 Mg/ha compost amendment. Model equations were derived for estimating fescue yield from compost-amended soil. (Author's abstract)

MUTAGENIC POTENTIAL OF MUNICIPAL SEWAGE SLUDGE AMENDED SOILS.

Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.

K. C. Donnelly, K. W. Brown, and J. C. Thomas. Water, Air and Soil Pollution WAPLAC, Vol. 48, No. 3/4, p 435-449, November 1989. 4 fig, 3 tab, 24 ref.

Descriptors: *Bacterial physiology, *Land disposal, *Mutagenicity, *Mutagens, *Sludge disposal, *Soil amendments, Bioassay, Municipal wastes, Soil physical properties, Solvent extraction.

This study was conducted to measure the mutagenic potential of municipal sewage sludge amended soil. Two separate sludge samples were collected from one municipal wastewater treatment plant and applied to undisturbed soil lysimeters over a nine month interval. Soil and sludge samples were collected for approximately two years following sludge application. Samples were extracted using methylene chloride and methanol, and the bacterial mutagenicity of the resulting residue determined using the Salmonella/microsome assay. The maximum specific activity in net revertants per 10 mg of residue induced by the methanol fraction extracted from the soil collected 154 days following the first sludge application was 416 for the sludge amended soil, as compared to 320 for the Padina sand. The specific activity of the sludge amended soil decreased slowly with time. For both the Padina and the Weswood soils, mutagenic organic chemicals were detected in soil samples collected 510 days following the second sludge application. For the Weswood soil, the mutagenic activity per unit weight of soil with metabolic activation of the samples collected 510 days after the final sludge application was decreased by 15 and 76% for the methylene chloride and methanol fractions, respectively, when compared to the maximum weighted activity observed 56 days after the final sludge application. The results indicate that municipal sewage sludges may contain organic mutagens which are persistent in the soil. (Author's abstract) W90-07131

EXCAVATION OF AN INSTRUMENTED EARTHEN LINER: INSPECTION OF DYED FLOW PATHS AND MORPHOLOGY. Illinois State Geological Survey Div., Champaign. For primary bibliographic entry see Field 5G. W90-07227.

CONSTRUCTION OF THE IONA OUTFALL SUBMARINE SECTION.
Dillingham Construction Ltd., North Vancouver (British Columbia).

(British Columbia). For primary bibliographic entry see Field 8A. W90-07237

ROOT AND SHOOT ELONGATION AS AN AS-SESSMENT OF HEAVY METAL TOXICITY AND 'ZN EQUIVALENT VALUE' OF EDIBLE CROPS.

Hong Kong Baptist Coll., Kowloon. Dept. of Biol-

ogy. Y. H. Cheung, M. H. Wong, and N. F. Y. Tam. Hydrobiologia HYDRB8, Vol. 188/89, p 377-383, December 1989. I fig, 1 tab, 17 ref.

Descriptors: *Bioassay, *Crops, *Heavy metals, *Land disposal, *Phytotoxicity, *Plant growth, *Pollutant identification, *Sludge disposal, *Toxicity, Aluminum, Cabbage, Cadmium, Copper, Hong Kong, Iron, Lead, Manganese, Nickel, Root growth, Shoot growth, Silver, Soil amendments, Zinc.

Seeds of thirteen edible plant species were tested for their response to heavy metals during their early development. It was found that a short-term root elongation test of six days could be used to evaluate the degree of toxicity of aqueous samples containing heavy metals. Shoot elongation was less sensitive to metals than root elongation. The seeds were sown in pots containing freshwater sand to which known concentrations of metal solutions were added. The relative toxicity of the three metals, copper, nickel, and zinc, followed the pattern of Ni > Cu > Zn. Results on the relative toxicity of Zn:Cu:Ni: to various plant species indicated that the ratios were species-specific. The Znequivalent concept of Zn:Cu:Ni: = 1:2.8 could not be applied to all the plant species tested. The root growth of seeds of Brassica parachinensis (flowering Chinese cabbage) placed on filter papers in petri dishes to which metal solutions were added was tested. The sensitivity ranking of the metals tested was found to be as follows: Ni > Cd > Cu > Al > Fe > Zn > Pb > Mn > Ag. There was no significant difference (p > 0.05) in percentage reduction in root elongation among the four different repeated trials. It is expected that parts of the sewage sludge generated by the existing as well as future sewage treatment plants in Hong Kong will be used for agricultural application. The root elongation method will be useful as a convenient tool to evaluate the phytotoxicity of heavy metals contained in the sludge. (White-Reimer-PTT)

ROLE AND APPLICATION OF ENVIRON-MENTAL BIOASSAY TECHNIQUES IN SUP-PORT OF THE IMPACT ASSESSMENT AND DECISION-MAKING UNDER THE OCEAN DUMPING CONTROL ACT IN CANADA.

Environmental Protection Service, Dartmouth (Nova Scotia). Marine Environmental Branch. K. L. Tay.

K. L. Tay. Hydrobiologia HYDRB8, Vol. 188/89, p 595-600, December 1989. 1 fig, 2 tab, 14 ref.

Descriptors: *Bioassay, *Canada, *Ocean dumping, *Sediment contamination, *Toxicity, *Water pollution effects, Benthic organisms, Impact assessment, Microbiological studies, Single-species tests.

A brief description of the Canadian Ocean Dumping Control Act (ODCA) and the current ocean dumping permit process in Canada is given. Using case studies the role of various experimental bioassay techniques and in situ bioaccumulation studies in the permit assessment and evaluation process are reviewed. A single-species test, such as the Macoma or Amphipod test, might be useful in detecting the toxicity of a few selected pollutants.

However, when the assessment of more complex environmental impacts caused by the dumping of multiple contaminated substances is required, a battery approach using single species lethal and subletal bioassays supplemented with bulk sediment chemical analysis and benthic community studies is more applicable. The test organisms in existing sediment bioassay tests are usually species that are alien to the benthic community at the dump site. The new microbial tests have adopted a different approach by directly measuring the metabolic disturbance in a natural benthic community caused by the impacts of ocean dumping at the dump site. The use of organisms obtained from the dump site will increase the accuracy in predicting the 'true' impact of dumping wastes at sea. Results of bioassays will provide useful feedback for the establishment of better criteria for the ODCA Permit reviewing system. (White-Reimer-PTT)

ENVIRONMENTAL ASPECTS OF PHOS-PHATE FERTILIZER PRODUCTION IN THE NETHERLANDS WITH PARTICULAR REFER-ENCE TO THE DISPOSAL OF PHOSPHOGYP-SIM

Gezondheidsraad, The Hague (Netherlands). For primary bibliographic entry see Field 5B. W90-07345

EFFECT OF THE APPLICATION OF A MUNICIPAL REFUSE COMPOST ON THE PHYSICAL AND CHEMICAL PROPERTIES OF A SOIL.

Instituto de Edafologia y Biologia Vegetal, Madrid (Spain).

(Spain).
S. Hernando, M. C. Lobo, and A. Polo.
Science of the Total Environment STENDL, Vol.
81/82, p 589-596, June 1989. 2 fig, 6 tab, 9 ref.

Descriptors: *Heavy metals, *Land application, *Municipal wastes, *Soil amendments, *Soild waste disposal, *Waste disposal, Cadmium, Chromium, Compost, Copper, Lead, Nickel, Soil chemistry, Soil properties, Soil structure, Zinc.

Three doses of a municipal refuse compost were applied to a soil (Typic Haploxeralf) from Toledo, Spain. Subsequent changes in soil physical and chemical properties, and in the solubility of toxic metals in water and diethylentriaminpentaacetic acid (DTPA) were studied. Soil structure was improved and water holding capacity and alkalisoluble substances increased. Analyzing the toxic metals dynamics, a different behavior was observed in each element in both aqueous and DTPA extracts. Chromium was not extractable in either extracting agents. The hydrosoluble zinc was immobilized during the incubation while it became concentrated in the DTPA extracts. Copper presented an opposite behavior with an immobilization in the DTPA fraction and a release in the aqueous extract. A significant correlation at 95% was found between the amount of soluble copper and that of compost added. Nickel mobilized both in water and in DTPA. There was a significant correlation between the contents of the available extracts in the various doses and the aggregate stability, presenting possible contamination risks directly proportional to dose. (Geiger-PTT)

EVALUATION OF MID-TO-LONG TERM BASIC RESEARCH FOR ENVIRONMENTAL RESTORATION: PRELIMINARY ANALYSIS TO CHARACTERIZE DOE WASTE PROB-LEMS IN A 5-TO 20-YEAR TIMEFRAME AND TO IDENTIFY RESEARCH NEEDS.

Department of Energy, Washington, DC. Office of Energy Research. For primary bibliographic entry see Field 5G. W90-07486

CALIFORNIA DIVISION OF OIL AND GAS UNDERGROUND INJECTION CONTROL PROGRAM: A PEER REVIEW.

Underground Injection Practices Council, Oklahoma City, OK.

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5E-Ultimate Disposal Of Wastes

Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA. 22161, as DE89-012489. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/BC/14304-T1, 1989. 115p.

Descriptors: *California, *Injection wells, *Regulations, *Wastewater disposal, Compliance, Handbooks, Natural gas, Oil industry, Peer review.

The peer review of the California Division of Oil and Gas Class II Underground Injection Control (UIC) program was conducted in Sacramento, California, in March, 1988, to assess the overall effectiveness of State oil and gas environmental programs. The review was conducted using a comprehensive questionnaire completed by state UIC researched direct questioning of these personnel prehensive questionnaire completed by state UIC personnel, direct questioning of these personnel by Review Team members and review of actual documents and procedures used. The programs examined cover wells which are used for the injection of fluids into oil reservoirs for the purpose of stimulating or furthering their production when natural production mechanisms decline or cease fleshanced recovery well) and for the disposal of (enhanced recovery well) and for the disposal of waters produced in conjunction with the production of oil and gas (disposal wells). If improperly constructed, operated, maintained, or abandoned, constructed, operated, maintained, or abandoned, such wells may allow contaminants to enter underground sources of drinking water (USDW) potentially depriving the public of needed sources of current or future water supplies. A review questionnaire workbook was prepared containing numerous questions about the important aspects of a state's Class II UIC program including: (1) permitting and file review; (2) inspections; (3) mechanical integrity testing; (4) compliance and enforcement; (5) plugging and abandonment; and (6) inventory and data management. (Lantz-PTT) W90_07499

BIOLOGICAL TESTING OF SEDIMENT FOR THE OLYMPIA HARBOR NAVIGATION IM-PROVEMENT PROJECT, 1988: GEODUCK, AMPHIPOD, AND ECHINODERM BIOAS-

Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.

For primary bibliographic entry see Field 5C. W90-07500

DREDGING: BIOLOGICAL EFFECTS (JAN 79 -

National Technical Information Service, Springfield, VA.

For primary bibliographic entry see Field 6G. W90-07501

5F. Water Treatment and Quality Alteration

OPERATING EXPERIENCE OF AN R. O. PLANT AS PRETREATMENT OF THE DEMINERALIZER SYSTEM IN A COGENERATION

Power Resources, Inc., Big Spring, TX. For primary bibliographic entry see Field 3A. W90-06557

GRAPHIC EVOLUTION OF THE 24,000 HOURS (3 YEARS), OPERATING DATA OF A RO BRACKISH WATER DESALINATION PLANT, IN LAS PALMAS, CANARY ISLANDS,

Universidad Politecnica de Canarias, Las Palmas de Gran Canaria (Spain). Escuela Tecnica Superior de Ingenieros Industriales de Las Palmas. For primary bibliographic entry see Field 3A.

REVERSE OSMOSIS AND ION EXCHANGE DEMINERALIZER SYSTEM FOR BASRAH PETROCHEMICAL COMPLEX NO. 1. For primary bibliographic entry see Field 3A. W90-06559

THM PRECURSOR REMOVAL AND SOFTEN-ING--FT. MYERS 12 MGD RO MEMBRANE PLANT, FLORIDA USA.

Hydranautics, San Diego, CA.
P. H. Lang, P. E. Laverty, E. D. Edwards, and I.

Watson.
Desalination DSLNAH, Vol. 76, No. 1-3, p 39-52,
November 1989. 10 fig, 1 tab.

Descriptors: *Florida, *Membrane processes, *Reverse osmosis, *Trihalomethanes, *Water softening, *Water treatment, *Water treatment facilities, Performance evaluation, Pilot plar techniques, Water quality standards. evaluation, Pilot plants, Separation

The city of Ft. Myers, Florida currently lime softens up to 10 million gallons/day (1600 cubic m/hr) of raw water from a well field in a process including aeration, lime softening, clarification, re-carbonation, chlorination, and media filtration. The water, as presently treated, exceeds the regulatory limit for trihalomethane by a factor of four (400 microgram/L vs. regulatory limit of 100 microgram/L). Due to a need to expand capacity and comply with trihalomethane regulations, the city compily with trinaiometriane regulations, the city investigated process alternatives, and found that membrane separation of organics (trihalomethane precursor) and hardness more reliably meets existing requirements and proposed future trihalomethane limits, at no additional cost compared to more conventional chemical processes. Subsequent to conventional chemical processes. Subsequent to the treatment study, membrane pilot testing was conducted, a membrane supplier was selected, and proof testing was successfully completed during the summer of 1988. The Hydranautics membrane type selected for the Ft. Myers production system and used in the proof test was treating a similar surficial feed source for another large South Florida utility. Operation of the production plant during 1988 and 1989 has confirmed long-term perform-ance stability of the Hydranautics ultralow pres-sure membrane. (Mertz-PTT) W90-06560

'DESIGN OF COMPACT, CONTAINERIZED DESALINATION PLANTS' EXECUTED FOR MINISTRY OF ELECTRICITY AND WATER,

Hydrotechnik, Salzburg (Austria). For primary bibliographic entry see Field 3A. W90-06561

DESAL-5 MEMBRANE FOR WATER SOFTEN-

Desalination Systems, Inc., Escondido, CA. D. L. Constock. Desalination DSLNAH, Vol. 76, No. 1-3, p 61-72, November 1989. 4 fig, 2 tab, 2 ref.

Descriptors: *Membranes, *Reverse osmosis, *Ultrafiltration, *Wastewater treatment, *Water softening, *Water treatment, Computer programs, Desalination apparatus, Ions, Membrane processes, Separation techniques, Sulfates.

Desal-5 is a thin-film membrane developed by Desalination Systems, Inc. It falls into the overlap salination Systems, Inc. It falls into the overlap region between reverse somosis and ultra-filtration with an approximate molecular weight cut-off of 150 to 200 for uncharged molecules. Multivalent anions are highly rejected by the membrane. Depending upon the ionic makeup of the water, divalent cations may also be highly rejected while monovalent ions are allowed to pass. These unique properties make the Desal-5 membrane ideal for a number of industrial separation and purification applications and for hardness and sulfate removals. applications and for hardness and sulfate removal from natural water and wastewaters. In addition to softening, Desal-5 is capable of removing a variety of organic constituents from natural waters, wastewaters, and process streams. A calculation procedure was developed that predicts ion rejection with a reasonable accuracy. The calculation procedure is amenable to computerization, and a computer projection program is presently being prepared. (Mertz-PTT) W90-06562

JEDDAH 1 RO PLANT--PHASE I 15 MGD RE-VERSE OSMOSIS PLANT.

Saline Water Conversion Corp., Jeddah (Saudi Arabia). For primary bibliographic entry see Field 3A. W90-06563

INTEGRATED PRODUCTION OF POWER

AND WATER.
Saline Water Conversion Corp., Al-Khobar (Saudi Arabia). M. A.-K. Al-Sofi.

Desalination DSLNAH, Vol. 76, No. 1-3, p 89-105, November 1989. 5 fig, 3 tab, 16 ref.

Descriptors: *Arabian Peninsula, *Electric power demand, *Electric power production, *Water demand, *Water supply, Developing countries, Spinning reserve, Water distribution, Water supply development.

In the Arabian Peninsula, both water and power In the Arabian Peninsula, both water and power are becoming more and more vital commodities. This is mainly due to the improving quality of life and to industrialization. Furthermore, due to limited natural resources that its industrial production is growing very rapidly. The production growth rate of water is twice of that for power. This is largely attributable to the rapid quantitative and qualitative deterioration of underground water, which in turn is related to escalating demands. Unlike water, electricity is a product which is difficult to store. This characteristic nature of the two may be utilized to partially alleviate the uneven demand lized to partially alleviate the uneven demand growth rates. Likewise, deployment of water pro-duction processes of a different nature and energy requirements would also assist in meeting the requirements would also assist in meeting the higher demands. Spinning reserve or available gen-eration capacity is the major network protection concept in the region, where both water and power are industrially produced. It would there-fore be worthwhile to investigate ways and means of utilizing the spinning reserve. Particular atten-tion should be given to the close relationship existing between power and water production. (Author's abstract) W90-06564

CONCENTRATION OF RO-BRINES BY SEEDED HORIZONTAL TUBE FALLING FILM EVAPORATION (HTFE). Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Verfahrenstechnik 1 und Inst. fuer

Verfahrenstechnik

For primary bibliographic entry see Field 3A. W90-06565

TECHNOECONOMICS OF POWER/DESALT-ING COGENERATION PLANTS IN KUWAIT--A PRELIMINARY STUDY.
Kuwait Water Resources Development Centre,

For primary bibliographic entry see Field 3A. W90-06566

OPTIMIZATION OF DUAL-PURPOSE STEAM POWER AND MSF DESALINATION PLANT. Consulting Engineers, P.O. Box 223, Heliopolis, Cairo, Egypt.
For primary bibliographic entry see Field 3A.

W90-06567

OPTIMUM DESIGN FOR A HYBRID DESALT-ING PLANT. King Saud Univ., Riyadh (Saudi Arabia). Coll. of Engineering. For primary bibliographic entry see Field 3A.

W90-06568

HYBRID DESALTING SYSTEMS. Bechtel Group, Inc., San Francisco, CA. For primary bibliographic entry see Field 3A.

COSTS OF SEAWATER DESALINATION IN REAL TERMS, 1979 THROUGH 1989, AND PROJECTIONS FOR 1999.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration—Group 5F

Leitner and Associates, Inc., Elm Grove, WI. For primary bibliographic entry see Field 3A. W90-06570

COMPREHENSIVE STUDY ON CAPITAL AND OPERATIONAL EXPENDITURES FOR DIFFERENT TYPES OF SEAWATER DESALTING PLANTS (RO, MYC, ME, ME-TYC, MSF) RATED BETWEEN 200 CUBIC M/D AND 3000 CUBIC M/D.

TRACTEBEL S.A., Brussels (Belgium). For primary bibliographic entry see Field 3A. W90-06571

PARAMETRIC COST ANALYSIS STUDY OF SEAWATER REVERSE OSMOSIS SYSTEMS DESIGN IN KUWAIT. Kuwait Water Resources Development Centre,

For primary bibliographic entry see Field 3A. W90-06572

TECHNICAL AND ECONOMICAL COMPARISON BETWEEN LARGE CAPACITY MSF AND RO DESALTING PLANTS.

Kuwait Univ., Safat. Dept. of Mechanical Engi-For primary bibliographic entry see Field 3A. W90-06573

TECHNICAL ASPECTS OF REDUCING DESALTING WATER COST BY DISTILLATION METHODS.

Kuwait Univ., Safat. Dept. of Mechanical Engi-

For primary bibliographic entry see Field 3A. W90-06574

PROCESS ARRANGEMENTS FOR HYBRID SEA WATER DESALINATION PLANTS For primary bibliographic entry see Field 3A. W90-06575

ADSORPTION METHODS FOR TREATING ORGANICALLY COLOURED UPLAND WATERS.
Imperial Coll. of Science and Technology, London

Imperial Coll. of science and Technology, London (England). Dept. of Civil Engineering. S. D. Lambert, and N. J. D. Graham. Environmental Technology Letters ETLEDB, Vol. 10, No. 9, p 785-798, September 1989. 64 ref.

Descriptors: *Adsorption, *Chemical treatment, *Color removal, *Water treatment, Activated alumina, Activated carbon, Bone char, Coagulation, Costs, Filtration, Sedimentation.

Conventional color removal treatment is per-formed by a process of coagulation with a hydro-lyzing salt, such as aluminum sulfate, followed by either sedimentation (or flotation) and filtration, or either sedimentation (or flotation) and filtration, or direct filtration, prior to disinfection. These conventional methods, when treating highly colored upland raw waters for potable water supply, are relatively inefficient. Adsorption of organic color either by activated carbon, by activated alumina, or by bone char, particularly after preozonation of the raw water, is a possible alternative method that may be more cost-effective. The principal properties relating to the viable application of an adsorbent are: its adsorption characteristics, physical characteristics, and regeneration capability. Of these, an adsorbent's adsorption capacity describes the key economic factor in the adsorption process as it determines the direct cost in terms of both the the key economic factor in the assorption process as it determines the direct cost in terms of both the rate of adsorbent exhaustion, and the sizing of the necessary equipment. It may be possible for activated carbon to be regenerated with solvents but as both solvents and adsorbates vary in their deas oon solvens and ausoroates vary in their de-sorptive characteristics, no solvents are universally applicable, and there are several disadvantages with the employment of some organic solvents on an industrial scale. They are often expensive and must be recovered, and there may be health haz-ards. The chemical regeneration of activated carbon is also not always very effective, with efficiencies of only 13.0-72.2 ppt with 10 ppt hy-

drochloric acid, and 8.0-44.0 ppt with 6M sodium hydroxide solutions. Alumina however, permits a rapid, insitu recovery of a high proportion of the adsorptive capacity, it causes no attrition, it avoids adsorbent handling and make up requirements, and it also avoids pollution problems and the generation of high temperatures. The reuse of regenerant solutions is a further economic benefit. The dissolution of material during alumina regeneration however may hinder its application. A particular advantage of bone char is its low cost in comparison to the other adsorbents and this may compensate for some of its deficiencies. Similarly, activated bauxite may be an attractive alternative adsorbent. Although less effective than activated alumina, activated bauxite is still an excellent adsorbent of fluoride from waters of varying composition, and is much less expensive. (Brunone-PTT)

PRODUCTION AND COST FUNCTIONS OF WATER LOW-TEMPERATURE SOLAR DESALINATION.

Patras Univ. (Greece). Dept. of Mechanical Engi-

neering.
For primary bibliographic entry see Field 3A.
W90-06654

IMPROVING RURAL SUPPLIES IN NORTH-

UMBERLAND.
Newcastle and Gateshead Water Co., Newcastle upon Tyne (England).
D. B. James, and B. E. Drage.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 564-568, December 1989. 4 fig, 2 tab.

Descriptors: *Drinking water, *Rural areas, *Water distribution, *Water quality, *Water supply development, *Water treatment facilities, England, Northumberland.

A strategy is described which was adopted to ensure compliance with the EC Directive on A strategy is userned which was autified to normalize compliance with the EC Directive on Drinking Water at six rural locations in Northumberland, UK. These areas, plus a more widespread community in the Tyne Valley, are served by Catcleugh reservoir, a typical upland colored source. Treatment of the smaller locations was carried out by single-stage pressure-filter plants, and for the larger area by a two-stage treatment works. Three of the small pressure-filtration plants have been closed, and the supply has been replaced from the two-stage plant. In the other three cases, two improvements are complete: one a dissolved-air flotation scheme, the other low-rate single-stage pressure filtration. Improvements to the third station are in the planning stage. (Author's abstract) W90-06715

PROBLEMS ENCOUNTERED IN THE HOTWELLS DISTRICT SMALL-SCALE ME-TERING TRIAL

Bristol Waterworks Co. (England).

Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 579-582, December 1989. 2 ref.

Descriptors: *User charges, *Water costs, *Water metering, Apportionment, Bristol, Electrical earthing, England.

As the debate on the fairness of water metering continues, the Hotwells, Bristol, UK metering trial continues, the Hotwells, Bristol, UK metering trial has revealed two new contentious issues which could add credibility to the arguments of those opposed to a universal system: apportionment and electrical earthing. While one of the original objectives of the trial has been to meter externally, it has always been recognized that not all properties lend themselves to siting of meters in the footpaths. Likewise, it has not even been possible to meter individual properties internally, and therefore it has been necessary to accept some premises' sharing a meter. This has resulted in the apportionment of measured volumes between those sharing, and of measured volumes between those sharing, and billing customers for those parts of the bill which are due to them. The water industry is presented with three options to deal with shared supplies: (1)

to develop an acceptable method of apportionment which will be viewed as fair by the customer, while being sufficiently simple to manage and maintain; (2) to set aside funds for the separation of supplies as metering becomes necessary; (3) to seek an alternative method of charging for shared services and totally dispense with metering. With respect to electrical earthing, two major problems have emerged during the trial. Firstly, installing a water meter breaks the conductivity of metallic pipework and, secondly, the customer does not realize or indeed accept responsibility for electrical earthing. These problems, while they have always existed below the surface, have recently come to a head because metering is compulsory, expensive, is head because metering is compulsory, expensive, is often unpopular and if it involves the customer in additional expense or danger, it is potentially a political issue. (Sand-PTT)
W90-06717

LABORATORY SIMULATION OF DISINFECTION REGIMES FOR TRIHALOMETHANE

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering. N. J. D. Graham, G. Reynolds, D. Buckley, R. Perry, and B. Croll.

Perry, and B. Croil.

Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 604-611, December 1989. 2 fig, 8 tab, 8 ref.

Descriptors: *Chlorination, *Chlorine dioxide, *Disinfection, *Drinking water treatment, *Ozonation, *Ozone, *Trihalomethanes, *Water treatment, Chlorine, Permanganate.

A collaborative project between Anglian Water and Imperial College was undertaken to investigate alternative disinfection regimes for the control trihalomethane (THM) formation in lowland surface water treatment. A laboratory experimental protocol was developed to measure THM formation as a consequence of both pre-disinfection and post-disinfection stages with chlorine dioxide, ozone and potassium permanganate, evaluated as alternative pre-disinfectants in direct comparison with breakpoint and sub-breakpoint pre-chlorination. The protocol was applied to raw water samients. with breakpoint and sub-breakpoint pre-chlorina-tion. The protocol was applied to raw water sam-ples from eight locations within the Anglian Water region under winter and summer conditions. The results have shown that THM formation can be reduced substantially, either by the application of chlorine dioxide and ozone as substitutes to break-point pre-chlorination or by reducing the pre-chlorination dose. The application of potassium permanganate as a pre-disinfectant had little effect on diminishing the formation of THM compounds. A further substantial reduction in THM formation can be achieved by diminishing the contact period following post-chlorination between free-chlorine and the treated water (e.g., by conversion of freeand the treated water (e.g., by conversion of free-chlorine to combined-chlorine through reaction with ammonium sulfate). (Author's abstract) W90-06721

REPORT FROM MALAWI, AFRICA.

N. A. MacDougall.

Journal of the Institution of Water Engineers and Scientists JJWSDI, Vol. 3, No. 6, p 619-620, De-

Descriptors: *Developing countries, *Malawi, *Sanitation, *Water supply development, Groundwater, Institutions.

Malawi, in South Eastern Africa, has substantial Malawi, in South Eastern Africa, has substantial water resources, with about one-quarter of the country being covered by lakes. Malawi has distinct wet and dry seasons, the wet season lasting from November to May, with slight regional variations. Groundwater is also widely available from dug wells and boreholes. The country's water resources are managed by the Water Resources Board. The city councils are responsible for sanitation in the cities with vareal responsibility responsibility. board. The city councils are responsible for samina-tion in the cities, with overall responsibility resting with the Ministry of local government. There are three major institutions dealing with water supply. The Department of Water is responsible for the following water supplies: urban water supplies; gravity-fed water systems; borehole water supplies;

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the Water Resources Board, which is responsible for granting water-abstraction rights and consent to discharge effluents into water courses and/or in to discharge effluents into water courses and/or in the ground, and for controlling water pollution; the Mpira/Balaka water supply, which will supply drinking water by a gravity piped system from Mpira Dam. The Blantyre Water Board, estab-lished in 1929 to provide the first piped water supply in Blantyre, Malawi's commercial center and largest city, has undertaken a development and largest city, has undertaken a development strategy to increase the peak yield from Walker's Ferry treatment works and raising the spillway of the Mudi Dam. The Lilongwe Water Board ob-tains its raw water from the Lilongwe River. Reg-ulation of river flows to provide storage during the ulation of river flows to provide storage during the dry season is achieved by the Kamuzu Dam and a newly-completed earthfill embankment dam. About 15% of the urban population is connected to community wastewater systems, the remainder generally using septic tanks and pit latrines. In order to improve and expand alternative low-cost sanitation techniques, a demonstration project has been carried out under the Lilongwe Water Supply Engineering Project. (Sand-PTT) W90-06723

PRETREATMENT ALTERNATIVES FOR CATSKILL WATER.

Hazen and Sawyer, New York. D. Nickols.

D. Nekols. Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 4, p 175-187, December 1989. 8 fig, 4 tab, 7 ref.

Descriptors: *Drinking water, *Pretreatment of water, *Water treatment facilities, Catskill Mountains, Dissolved oxygen, Filtration, New York, Pilot plants, Sedimentation basins, Turbidity.

The Catskill system provides 40% of the water for New York City. Two unusual features of the Catskill reservoirs need to be taken into account in the design of treatment facilities. (1) turbidity, which can rise dramatically in the spring run-off season; and (2) a function of the profile along the aqueduct, which is provided with inverted siphons along its length, usually at river and stream crossings. While fully submerged at normal flow, under reduced flow conditions the siphons are no longer fully submerged. Many have a free fall of several feet at the unstream end, which causes supersaturfeet at the upstream end, which causes supersaturated concentrations of dissolved oxygen in the siphon and for some distance downstream. As the siphon and for some distance downstream. As the turbidity of the Catskill water can exceed 100 NTU, pretreatment prior to filtration is necessary. Preliminary screening of alternatives was carried out prior to pilot testing. The alternatives considered were: conventional horizontal sedimentation basins; plate settlers; aludge blankets and solids. basins; plate settlers, studge blankets and solids contact clarifiers, and roughing filters. In pilot plant testing, although the plate settlers could meet the clarified water objectives under normal conditions, the presence of supersaturated dissolved oxygen caused significant floc carryover into the clarified water. The plate settlers could not meet the clarified water objectives under this condition. The dissolved air flotation cell results were initially disappointing, although still acceptable according to the test objectives. When an inclined baffle was added to make the rented unit more similar to European drinking water designs, the results im-proved dramatically. Supersaturated dissolved oxygen was not found to cause any deterioration in clarified water quality. The roughing filter results also met the test objectives, although the roughing also met the test objectives, although the roughing filter was not operated during periods of supersaturated dissolved oxygen. A report from the State Department of Health compared treatment plants using roughing filters at 10 gpm/sq ft with dissolved air flotation cells at 2.4 gpm/sq ft. The cost difference between the two processes was negligible, and the town has decided to proceed with dissolved air flotation cells rather than roughing filters. (Sand-PTT) W90-06727

RAW WATER QUALITY CONTROL: AN OVERVIEW OF RESERVOIR MANAGEMENT TECHNIQUES. Ecosystem Consulting Service, Inc., Coventry,

For primary bibliographic entry see Field 5G. W90-06728

CONTEMPORARY TELEMETERING METH-ODS FOR WATER WORKS FACILITIES. Consulting Engineer, Inc., Westwood, MA. For primary bibliographic entry see Field 7B. W90-06729

GRANULATED ACTIVATED CARBON WATER TREATMENT AND POTENTIAL RADIATION HAZARDS

HAZARDS.
Environmental Protection Agency, Boston, MA.
Water Supply Branch.
S. Rydell, B. Keene, and J. Lowry.
Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 4, p 234-248,
December 1989. 8 fig. 1 tab, 12 ref.

Descriptors: *Activated carbon, *Granular activated carbon, *Hazardous materials, *Radon, *Water treatment, Costs, Domestic water, Gamma radiation, Model studies, Radioactivity.

Early enthusiasm for granular activated carbon (GAC) as the radon treatment medium of choice for very small systems has diminished in consideration of the secondary radiation problems it presents. GAC remains a viable treatment method for radon only at the low end of the radon concentration range. In domestic water supplies this is 5000 pCi/l or less. The initial cost advantages of the GAC system may be overridden by the potential costs of dealing with problems of gamma radiation shielding or the need to regenerate or dispose of radioactive spent carbon should the system become plugged or otherwise fail. Model calculations of gamma dose allow design estimates for domestic systems to be made with reasonable accuracy. Using the model's point source dose feature should enable water system designers to estimate radiation osang the modes point source dose reature shound enable water system designers to estimate radiation exposures for larger units, since the point source calculation is independent of the shape or size of the source, and does not consider self-absorption within the source. On-site verification of gamma within the source. On-site verification of gamma dose by a recently calibrated survey meter, after several weeks of filter operation is good engineering practice and should be done to check the accuracy of the model calculation. (Author's abstract) W90-06730

RISK ANALYSIS ON AIR EMISSIONS FROM

GROUNDWATER AERATION.
Midwest Research Inst., Cary, NC.
R. V. Crume, W. M. Ryan, T. A. Peters, and R. J.

Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 119-123, March/April 1990. 1 fig, 5 tab, 9 ref.

Descriptors: *Air stripping, *Benzenes, *Cancer, *Chlorinated hydrocarbons, *Risk assessment, *Water treatment, Carcinogens, Chloroform, Groundwater pollution, Methylene chloride, Perchloroethylene, Trichloroethylene.

An air quality analysis and health risk assessment was performed to determine the potential inhalation risk associated with a proposed groundwater aeration tower located in the Los Angeles Basin. The tower was to be used to 'strip' contaminants from polluted groundwater, resulting in the discharge of the contaminants to the ambient air. charge of the contaminants to the ambient air. Emissions of trichloroethylene, perchloroethylene, benzene, chloroform, and methylene chloride were included in the study, based on the potential for these compounds to cause cancer in humans. A health risk assessment for each compound was conducted such that the potential impact of these compounds on the surrounding community could be evaluated. Both carcinogenic and noncarcino-genic effects were examined. The analysis indicatat the total excess burden in the area affected ou man me total excess outroel in the afrea affected by air stripping tower would be 0.032 excess cases of cancer over a 70-year period. The maximum individual cancer risk within the impacted area was found to be one-millionth. The maximum individual risk of cancer, population excess cancer burden, and concentration levels for assessing

acute effects were all judged to be acceptable by the South Coast Air Quality Management District. (Author's abstract) W90-06834

BIOHAZARDS TREATMENT. OF DRINKING WATER

Lewis Publishers, Chelsea, Michigan. 1989. 293p. Edited by Richard A. Larson.

Descriptors: *Biohazards, *Drinking water, *Hazardous materials, *Symposium, *Water quality control, *Water treatment, Amino acids, Biological control, Water Treatment, Amino acias, Biologica studies, Chemical reactions, Chlorinated hydrocar-bons, Chlorine, Disinfection, Granular activated carbon, Humic substances, Mutagens, Ozonation, Pathogens, Public health.

Pathogens, Public health.

The Environmental Chemistry Division of the American Chemical Society held its 194th meeting in New Orleans, Louisiana, in September 1987. The papers presented at the symposium called attention to the many problems that remain in trying to provide drinking water of good quality to the people of industrialized societies. These papers have been compiled into a book having seven sections (22 chapters). The opening section is devoted to an overview of public health risks related to drinking water treatment practices and the perception of these risks by users. The second section consists of chapters about chlorinated ethanes. In the third section, the question of pathogenic organisms in treated drinking water is examined. The fourth section of the book examines some of the chemical reactions between aqueous chlorine and common constituents of natural waters such as amino acids and humic materials, and delineates some of the efforts that have gone into identifying particularly active mutagens found in drinking water concentrates. The fifth section addresses the use of ozonation as an alternative disinfection process, including studies of ozonation products and their biological effects. Granular activated carbon ess, including studies of ozonation products and their biological effects. Granular activated carbon their biological effects. Granular activated carbon is the subject of the sixth section. The last section of the book includes several chapters on a variety of topics that represent advanced thinking about fundamental aspects of water treatment. This book attempts to stimulate thought about basic attitudes toward drinking water, helping to bring about the ideal of the safest drinking water for the greatest number of people. (See W90-06907 thru W90-06928) (Fish-PTT) W90-06906

HEALTH RISK IN RELATION TO DRINKING WATER TREATMENT.

Stichting Waterlaboratorium Oost, Doetinchem (Netherlands). H. J. Kool.

IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 3-19, 1 fig, 12 tab, 65 ref.

Descriptors: *Drinking water, *Water pollution effects, *Water treatment, Aeromonas, Carcinogens, Chlorination, Denitrification, Enteric bacteria, Groundwater pollution, Nitrates, Organic compounds, Oxidation, Ozone, Surface water, The Netherlands.

In the Netherlands about 30% of drinking water is produced from surface waters, mainly from the rivers Rhine and Meuse. These rivers are polluted with inorganics and pathogenic microorganisms. In order to be certain that the waterworks produce safe drinking water, treatment processes have to be applied. The use of a chlorination step, or other oxidation steps like ozone and chlorine dioxide, is applied to drinking water derived from surface water. Chlorine dioxide and ozone are preferred water. Chlorine dioxide and ozone are preferred over chlorine with respect to formation of mutagenic activity and organohalides in drinking water treatment. Evidence of carcinogenic effects caused by chlorinated drinking water is rather weak. Recently, 'new' problems that have shown up in drinking water supplies in The Netherlands include a finding of relatively high numbers of Aeromonas bacteria (an enteric pathogen) in drinking water prepared from surface water and groundwater, and a drastic increase in nitrate levels in groundwater drastic increase in nitrate levels in groundwater

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and drinking water. Nitrate removal by two deniand difficulty water. Printate removal by two deni-trification processes is now under investigation in a pilot plant study. (See also W90-06906) (Fish-PTT) W90-06907

ABIOTIC TRANSFORMATION OF HALOGE-NATED ORGANIC COMPOUNDS: II. CONSID-ERATIONS DURING WATER TREATMENT. Florida International Univ., Miami. Drinking Water Research Center. For primary bibliographic entry see Field 5B.

ELIMINATION OF VIRUSES AND BACTERIA DURING DRINKING WATER TREATMENT: REVIEW OF 10 YEARS OF DATA FROM THE MONTREAL METROPOLITAN AREA.

MUNIREAL METROPOLITAN AREA.
Institut Armand-Frappier, Laval (Quebec). Centre
de Recherche en Virologie.
P. Payment.
IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 5965, 2 fig, 6 tab, 1 ref.

Descriptors: *Enteroviruses, *Montreal, *Pathogens, *Water quality, *Water treatment, *Water treatment facilities, Canada, Drinking water, Filtration, Public health, Water quality control.

Pathogenic microorganisms found in water to be utilized for the preparation of drinking water should ideally be completely removed or inactivated by the treatment processes applied at the water filtration plant. However, many bacteria, viruses, and parasites have been found to be resistant to one or more of these treatments. Interest in the dissemination and survival of human and animal exteriors. nation and survival of human and animal enteric viruses in water has led to a study of not only their viruses in water has led to a study of not only their presence in surface water, but also of their survival during drinking water treatment as well as the health risk they may constitute. The water to be tested was obtained from seven drinking water treatment plants in Quebec, Canada, and conditioned to explane the indicated to the development. treatment plants in Queece, Canada, and contained to enhance virus adsorption to the electronegative cartridge filters. After filtration, the filters were eluted using an alkaline beef extract solution that was then flocculated to obtain a final volume of concentrate easily assayable in cell culture. As expected, the theories elaborated from laboratory scale experiments do not always correlate with the experimental data. Viruses were detected after treatments that should have eliminated more than 12-log of viruses. The data obtained at several water treatment plants indicate that, except under optimal conditions, most filtration plants will not remove all human enteric viruses. The low-level remove all numan enteric viruses. In e low-level viral contamination observed may not be a health problem, but only further studies will establish if such problems exist. Until then, because these viruses are so resistant to actual water treatment, they can be used as indicators of appropriate water treatment to detect deficiencies. (See also W90-06906) (Fish-PTT)

FACTORS AFFECTING THE OCCURRENCE OF THE LEGIONNAIRES' DISEASE BACTERI-UM IN PUBLIC DRINKING WATER SUP-PLIES.

PLIES.
Pittsburgh City Water Dept. PA.
S. J. States, J. M. Kuchta, L. F. Conley, R. S.
Wolford, and R. M. Wadowsky.
IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 6783, 7 fig. 2 tab, 37 ref. Environmental Epidemiology Center of the Graduate School of Public Health
of the University of Pittsburgh Cooperative Agreement CR80681-01-2 with the U.S. Environmental Protection Agency.

Descriptors: *Chlorine, *Drinking water, *Legionella, *Water conveyance, *Water quality control, *Water supply, *Water treatment, Bacterial analysis, Chlorination, Coliforms, Cooling towers, Metals, Municipal water, Plumbing, Water quality, Water tanks.

It has become apparent that the causative agent of legionnaires' disease, Legionella pneumophila, is a common inhabitant of internal plumbing systems of

hospitals, homes, and other buildings, and in bacterial amplifiers such as hot water heaters and coolrial amplifiers such as hot water heaters and cooling towers. The discovery of legionellae in these locations and its demonstrated ability to multiply in tap water raise questions concerning the potential role of public water supplies in contaminating internal plumbing systems, and of environmental factors within drinking water systems that influence the survival and growth of the organism. The susceptibility of L. pneumophila to chlorine was examined by inoculating tap water with known quantities of legionellae and treating these aquatic test systems with free chlorine. The results of this study indicate that Legionella is more resistant to test systems with free chlorine. The results of this study indicate that Legionella is more resistant to chlorine than are coliform bacteria, and that Legionella could potentially survive conventional chlorine levels typically found within portions of municipal drinking water systems. Analysis of water samples from institutional hot water tanks indicated that the chemical environment within these tanks varies extensively; the concentrations of certain metals reach high levels as a result of corrosion and leaching. It was indicated that while higher levels of most metals are toxic to Legionhigher levels of most metals are toxic to Legion-ella, lower concentrations of key metals (e.g., iron, zinc, and potassium) may enhance growth. Preven-tion of legionellae growth is aided by diligent application of conventional water treatment prac-tices. Operating cooling towers outside of the opti-mal environmental tolerance range for Legionella multiplication may be a useful approach to control-ling growth in this habitat. (See also W90-06906) (Fish-PTT) W90-06912

PRESENCE OF FUNGI IN DRINKING WATER. West Chester Univ. of Pennsylvania. Dept. of Biol-

ogy. W. D. Rosenzweig, and W. O. Pipes. IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 85-93, 3 tab, 35 ref. National Science Foundation, Division for Fundamental Research in Emerging and Critical Engineering Systems (ECE-8515710).

Descriptors: *Aquatic fungi, *Drinking water, *Fungi, *Water conveyance, *Water quality, *Water treatment, Aquatic habitats, Chlorine, Microbiological studies, Monitoring, Storage tanks, Water supply, Water temperature.

Fungi are active in degrading organic substrates in most habitats, including those of aquatic environments, and it is apparent that they are active in water distribution systems. The occurrence of fungi in five small water distribution systems in the Philadelphia, Pennsylvania, area was studied. Residential taps, elevated storage tanks, fire hydrants, chlorinated water in clear wells, aerated water, and raw water sources were sampled at various times between November 1980 and July 1987. Temperature and residual chlorine concentrations were measured at the time of sampling, then the fungi were colonized and identified. The counts per unit volume were relatively high in the raw water samples. The lowest occurrence and densiwater samples. The lowest occurrence and densities of fungi were found in the sample from residential taps in the groundwater systems. The lowest in the surface water samples were in the treated water (clearwell). The average fungal count per positive sample was highest in the storage tanks for groundwater systems and in fire hydrant samples for surface water samples. There is no evidence of differences in fungi present between groundwater and surface water systems. Apparently some fungi survive water treatment Apparently some fungi survive water treatment processes in small numbers, although the majority are eliminated. Relatively large numbers of fungi can be isolated from various parts of distribution systems, including various human pathogens. The exact role fungi might play in relation to human health and interference with the operation of the distribution system will require additional studies. (See also W90-06906) (Fish-PTT) W90-06913

PATHWAYS FOR THE PRODUCTION OF OR-GANOCHLORINE COMPOUNDS IN THE CHLORINATION OF HUMIC MATERIALS. Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.

For primary bibliographic entry see Field 5B. W90-06914

GC/MS IDENTIFICATION OF MUTAGENS IN AQUEOUS CHLORINATED HUMIC ACID AND DRINKING WATERS FOLLOWING HPLC FRACTIONATION OF STRONG ACID EXTRACTS.

Environmental Protection Agency, Cincinnati, For primary bibliographic entry see Field 5A.

AMINO ACIDS AS MODEL COMPOUNDS FOR HALOGENATED BY-PRODUCTS FORMED ON CHLORINATION OF NATURAL WATERS

Monsanto Co., St. Louis, MO. M. L. Trehy, R. A. Yost, and C. J. Miles.

IN: Biohazards of Drinking Water Treatment.

Lewis Publishers, Chelsea, Michigan. 1989. p 133-140, 3 fig. 33 ref.

Descriptors: *Amino acids, *Chlorination, *Halo-genated hydrocarbons, *Water treatment, Byprod-ucts, Chemical analysis, Chlorinated hydrocar-bons, Chloroform, Drinking water, Environmental quality, Florida, Nitrogen compounds, Pollutant identification, Trihalomethanes, Wastewater analy-

It is known that drinking water disinfected with chlorine contains trihalomethanes, which could be explained by the reaction of humic and fulvic substances with chlorine. Resorcinol-type moeities cannot account for the formation of dichloroace-tonitrile in chlorinated natural waters. The formatonitrile in chlorinated natural waters. The formation of dihaloacetonitriles (DHAN) by the reaction
of aqueous chlorine with amino acids or other
nitrogenous compounds with amino acid moeities
has been proposed. Certain amino acids such as
aspartic acid, tyrosine, and tryptophan yield
DHAN and chloral hydrate when exposed to
aqueous chlorine under conditions similar to that
used in water treatment. These amino acids react
with aqueous chlorine to yield dichloroacetonitrile,
chloral hydrate, and trichloromethane. Lake water
samples from Florida were chlorinated in order to
demonstrate the formation of both dichloroacetonsamples from Florida were chlorinated in order to demonstrate the formation of both dichloroaceton-itrile and chloral hydrate, in comparison to chlor-inated wastewater from an extended aeration wastewater treatment plant. Although the relative concentrations of dichloroacetonitrile and chloral hydrate were similar, the chloroform concentra-tion was substantially different, possibly reflecting different precursors for these byproducts. The environmental concentration of amino acids appears to be sufficient to account for the dichloroacetonitrile and chloral hydrate formed on chlorination of natural waters. The chlorination byproducts of natural waters. The chloradon hyproducts of amino acids are of concern, because amino acids are likely to be present in the environment and a portion of the byproducts formed on chlorination may be mutagenic. (See also W90-06906) (Fish-PTT) W90-06917

TOXICOLOGICAL SIGNIFICANCE OF THE CHEMICAL REACTIONS OF AQUEOUS CHLORINE AND CHLORAMINES.

Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.

F. E. Scully, K. Mazina, D. E. Sonenshine, and H.

P. Ringhand.

IN: Biohazards of Drinking Water Treatment.

Lewis Publishers, Chelsea, Michigan. 1989. p 141-

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Disinfection, *Drinking water, *Toxicology, *Water pollution sources, *Water treatment, Amino acids, Biological studies, Chemical reactions, Chlorine, Chloroform, Halogenated hydrocarbons, Organic compounds, Oxidation process, Pollutant identification, Proteins, Toxicity.

When a strong oxidizing agent, e.g., a drinking water disinfectant, is ingested, it can be expected to react with organic biomolecules present. Since

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F-Water Treatment and Quality Alteration

aqueous chlorine and organic monochloramine are widely used disinfectants, it is important to deter-mine what reactions these oxidants can undergo in the body and whether their products exhibit adverse health effects or can be detoxified. The prodverse neatth effects of can be detoxined. The products of the reactions of organic introgen compounds, major organic components of gastric fluid and important dietary constituents, with aqueous chlorine and monochloramine deserve attention. The reactions of aqueous chlorine and monochloramine deserve attention. amine with organic components of biological fluids from the stomachs of fasted laboratory rats were measured in many different ways, using oxidant concentrations high enough so that products could be recognized, isolated, and identified in the highly complex organic mixtures. It was found that various N-chlorinated amino acids, proteins, free chloous N-chlorinated amino acids, proteins, free chlorine, and chloroform were formed with various concentrations of the mixtures. The effects of these reactions may be extrapolated to oxidant concentrations used in toxicological studies and ultimately to oxidant concentrations ingested daily by humans. Operationally, it has been convenient to identify the halogenated products of the reactions of chlorine disinfectants with organics, because the presence of a chlorine atom is a specific indicator that a chlorination reaction has taken place. However, oxidation products that do not contain halothat a chiorination reaction has taken place. How-ever, oxidation products that do not contain halo-gen atoms are also possible and may exhibit toxico-logical effects of their own, but will be more difficult to identify. (See also W90-06906) (Fish-PTT W90-06918

OZONE OXIDATION PRODUCTS-IMPLICA-TIONS FOR DRINKING WATER TREAT-

Rice International Consulting Enterprises, Ashton, MD

R. G. Rice. IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 153-170, 1 fig 1 tab, 41 ref.

Descriptors: *Disinfection, *Drinking water, *Oxidation process, *Ozonation, *Water treatment, Aliphatic hydrocarbons, Biological treatment, Bromides, Carbon dioxide, Chlorine, Filtration, Floculation, Halogenated compounds, Insecticides, Mutagenicity, Ozone, Pesticides, Potassium compounds, Sand filters, Toxicity.

U.S. water utilities are being encouraged to consider the incorporation of ozone into drinking water treatment processing, primarily for disinfection, but also for oxidation. Oxidation products produced in water by ozone, chlorine, chlorine dioxide, chloramine, and potassium permanganate were surveyed. Each of these disinfectants/oxidants can surveyed. Each of these disinfectants/oxidants can be applied at various points in a conventional water treatment process. It was found that ozone produces organic oxidation products, largely aliphatic aldehydes, which are nonhalogenated and which generally are biodegradable. Although the aldehydes formed upon ozonation are not readily removed from solution by flocculation/filtration, they are readily decomposed biologically to they are readily decomposed biologically to carbon dioxide and water in sand filters. If bromide ion is present in the water being ozonized, brominated organic materials can be produced, once produced, halogenated organics are difficult to remove. Some pesticidal and insecticidal compounds produce intermediate oxidation products upon ozonation which are more toxic than the original compound. Low-level ozonation can produce low levels of mutagenicity. Higher applied ozone dosages produce waters containing no mutagenicity. Ozone should be added to water in the absence of these chlorinous reagents to avoid mutual destruction of both ozone and the chlorine-containing material. Combining prefiltration ozone ion is present in the water being ozonized, brominmutual destruction of both ozone and the catiorine-containing material. Combining prefiltration ozone oxidation with primary disinfection in the same treatment step will eliminate the need for postfil-tration primary disinfection with ozone, chlorine, or chlorine dioxide. (See also W90-06906) (Fish-PTT) W90-06919

FORMATION OF AROMATIC POLYMERS DURING THE OZONATION OF ENZYMATIC OXIDATION OF WATERS CONTAINING PHE-NOLIC COMPOUNDS

Centre de Recherche Lyonnaise des Eaux - Degre-

Centre de Recnerche Lyonause des Eaux - Degremont, Le Pecq (France).
J.-P. Duguet, A. Bruchet, B. Dussert, and J.
Mallevialle.
IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 171184, 10 fig, 2 tab, 12 ref.

Descriptors: *Aromatic compounds, *Oxidation process, *Ozonation, *Phenols, *Polymers, *Water pollution sources, *Water treatment, Byproducts, Chlorinated hydrocarbons, Coagulation, Enzymes, Molecular structure, Organic com-water, Toxicity, Ultraviolet radiation compounds,

Natural or synthetic organic compounds that are usually present in raw waters may cause taste and odor problems or represent a health risk, even at low concentrations. One means of increasing the removal efficiency is to use new processes b on the polymerization of aromatic compounds. on the polymerization of aromatic compounds. The polymerization effects obtained by ozonation were compared to enzymatic reaction on a chlorin-ated phenol, the 2,4-dichlorophenol (2,4-DCP). It was found that whatever the initial concentrations of 2,4-DCP, the elimination is better than 95% for low-ozone doses or enzymatic activities corresponding to small quantities of enzyme. If polymerization occurs by ozonation or enzymatic rea enzanon occurs by ozonanon or enzymanic reaction, some differences are noted: (1) enzymatic reaction produces a higher quantity of polymers that have molecular weights below 1000 daltons; (2) ultraviolet adsorption byproducts obtained by ozonation are generally more polar than those obtained by enzymatic reaction; and (3) dechlorination is more important in the case of ozonation. These oxidative techniques produced many identi-cal compounds even at low initial concentrations of 2,4-DCP. Polymerization techniques may be useful water treatment methods, but many questions must be resolved concerning the influence of the organic matrix on the removal efficiency, the the organic matrix on the removal efficiency, the nature of byproducts, the evolution of short-term and long-term toxicity levels, the detection of newly formed compounds, and the optimization for the removal of the polymerization byproducts by subsequent treatment such as coagulation. (See also W90-06906) (Fish-PTT)
W90-06920

BY-PRODUCTS FROM OZONATION AND PHOTOLYTIC OZONATION OF ORGANIC POLLUTANTS IN WATER: PRELIMINARY

OBSERVATIONS.
Illinois State Water Survey Div., Champaign.
G. R. Peyton, C. S. Gee, M. A. Smith, J. Bandy, and S. W. Maloney.
IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 185-

200, 7 fig, 22 ref.

Descriptors: *Organic compounds, *Ozonation, *Photolysis, *Pollutant identification, *Water pollution sources, *Water treatment, Byproducts, Carboxvlation, Chemical analysis, Chemical degradation, Chemical degradation, Chemical analysis, Chemical degradation, Chemical degradatio lution sources, "water treatment, pyproducts, var-boxylation, Chemical analysis, Chemical degrada-tion, Hydrogen ion concentration, Hydrogen per-oxide, Model studies, Organic acids, Oxidation process, Ozone, Toxicity, Toxins.

ent situations sometimes arise in which it would be desirable to destroy some highly toxic parent compound but impractical to eliminate all organic material from solution. It is therefore of organic material from solution. It is therefore of interest to identify byproducts from a given parent compound in order to assess the potential toxicity of the mixture which results from partial treatment. Identification of oxidation byproducts is important in order to develop a predictive model of the treatment processes. Aqueous solutions of model compounds were treated by photolytic ozonation in a stirred-tank photochemical reactor. ozonation in a stirred-tank photochemical reactor. Samples were withdrawn as a function of time Samples were withdrawn as a function of time during treatment, and carbonyl compounds derivatized. Samples were also withdrawn and analyzed for organic acids, ozone, hydrogen peroxide, and the pH measured. It was found that carbonyl compounds formed as products of oxidation reactions can react with hydrogen peroxide, which is frequently present in such systems, to establish an equilibrium between parent compounds and peroxidic products. There may be health implications, particularly in cases where drinking wate would

be consumed immediately following treatment. Phenylhydrazine derivatives of carbonyl com-pounds are oxygen-sensitive. Preliminary data on two model compounds whose peroxy radicals do not easily eliminate superoxide indicate that the postulated tetroxide intermediate is useful in ex-plaining the stable byproducts which are formed in photolytic ozonation experiments. Results of this type provide useful input into the mass balance model photolytic ozonation. (See also W90-06906) W90-06921

APPLICATION OF CLOSED LOOP STRIP-PING AND XAD RESIN ADSORPTION FOR THE DETERMINATION OF OZONE BY-PRODUCTS FROM NATURAL WATER.

California Univ., Los Angeles. W. H. Glaze, M. Koga, E. C. Ruth, and D.

Cancina.

IN: Biohazards of Drinking Water Treatment.

Lewis Publishers, Chelsea, Michigan. 1989. p 201
210, 6 fig. 2 tab, 9 ref. Los Angeles Department of Water and Power Cooperative Agreement CR
813188 with the U.S. Environmental Protection

Descriptors: *Chemical analysis, *Ozonation, *Pollutant identification, *Water analysis, *Water chemistry, *Water treatment, Adsorption, Aliphatic hydrocarbons, Aqueducts, Byproducts, California, Chemical treatment, Chlorination, Fatty acids, Filtration, Ozone, Polarity, Raw water, Resins, Sampling, Volatile organic compounds, Water treatment facilities Sampling, Volatile treatment facilities.

Much remains to be learned about the chemistry and potential health risks of ozone-produced by-products in drinking water. Closed Loop Stripping Analysis (CLSA) and XAD-4/8 resin adsorption methods can be used for the isolation of these byproducts. Three types of water samples were collected from the new Los Angeles (California) Aqueduct Filtration Plant: raw aqueduct water, post-ozone-treated water, and finished water. Finished water had passed through ozone, chemical treatment, filtration, and chlorination. Laboratory ozonations were carried out in a stainless steel ozonations were carried out in a stainless steel continuous stirred tank reactor (CSTR) equipped with a sparging disk at the base for introduction of ozone-containing gases. Water samples were analyzed by the CLSA method. One of two samples of raw aqueduct water was ozonated and both were passed through XAD-4/8 resin columns. In were passed through XAD-4/8 resin columns. In raw aqueduct water straight-chain aldehydes were commonly observed. After ozonation the concen-tration of strippable aldehydes increased, the major byproduct being heptanal. Analysis of finished water showed a lower concentration of strippable compounds. It can be concluded that these waters contain several compounds which can be analyzed conveniently by the CLSA procedure, best suited for the isolation and detection of semivolatile and semipolar compounds from water. Identified com-pounds after XAD-4/8 resin accumulation include pounds after XAD-4/8 resin accumulation include fatty acid methyl esters and aliphatic aldehydes. It is predicted that heptanal, a major product found in ozonated field and laboratory samples, will be produced as a byproduct of the ozone-induced decomposition of 9-hexadececenoic acid. Further studies of this model compound are in progress. (See also W90-06906) (Fish-PTT) W90-06922

ROLE OF GRANULAR ACTIVATED CARBON IN THE REDUCTION OF BIOHAZARDS IN DRINKING WATER.

Cincinnati Univ. Medical Center, OH. M. W. Tabor.

M. W. 18007.
IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 213233, 9 fig., 3 tab, 50 ref. USPS-NIEHS Grant No.
ES00159, USEPA Grant No. CR808603, and the
National Science Foundation Grant No. PCM-82

Descriptors: *Activated carbon, *Adsorption, *Bioassay, *Drinking water, *Granular activated carbon, *Water treatment, Alachlor, Ames test, Chemical analysis, Gas chromatography, High per-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration—Group 5F

formance liquid chromatography, Mass spectrome-try, Mutagenicity, Ohio, Pollutant identification, Salmonella.

The vulnerability of surface water to industrial accidents and spills, as well as the presence of trace levels of biohazardous compounds in finished drinking water prepared by conventional methods, has led to the proposed use of granular activated carbon (GAC) in the preparation of safe drinking water. Both virgin (control samples) and spent GAC were obtained from the Cincinnati (Ohio) Water Works. Bioassays were performed using the Salmonella microsome mutagenicity assay of Ames. Experiments to inactivate direct-acting mutagens via reaction with the nucleophile. 4-nitroth-Ames. Experiments to inactivate direct-acting mutagens via reaction with the nucleophile, 4-nitrothiophenol (NTP), were conducted. Gas chromatographic and mass spectrometry analyses of high performance liquid chromatography (HPLC) subfractions and SEP-PAK concentrates were performed on the appropriated hexane-Acetone, acetonitrile/water, or methylene chloride solution. The most significant result was the isolation of two distinct fractions of direct-acting mutagens from this complex mixture via HPLC, one of which was abile in terms of loss of bioactivity whereas the this complex mixture via HPLC, one of which was labile in terms of loss of bioactivity whereas the other was stable. This led to the stabilization of the labile mutagens as NTP-adducts, and one was tentatively identified, indicating the presence of a derivative related to the herbicide Alachlor. This derivative related to the herbicide Alachlor. This approach can be used for the identification of labile mutagens isolated from complex mixtures of residual organics in environmental samples. The success in the isolation of mutagens from the GAC further supports that GAC effluent drinking water was mutagen-free, whereas the influent waters contained measurable levels of mutagenic residual organics. Therefore, these results support the recommendation that GAC is a viable method for removing biohazardous organics from water. (See also W90-06906) (Fish-PTT) W90-06923

OXIDATION OF PHENOL ON GRANULAR ACTIVATED CARBON, Illinois Univ. at Urbana-Champaign. Inst. for Envi-

ronmental Studies

ronmental Studies. L. S. Chin, R. A. Larson, and V. L. Snoeyink. IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 235-242, 7 fig. 11 ref.

Descriptors: *Activated carbon, *Granular activated carbon, *Oxidation process, *Phenols, *Water treatment, Adsorption, Catalysts, Disinfection, Fulvic acids, Hydrogen ion concentration, Pollutant identification, Polymers.

In drinking water treatment, granular activated carbon (GAC) is widely used. However, many inorganic and organic adsorbates in aqueous solution are catalytically oxidized by activated carbon. It has been suggested that oxygen-containing surface groups take part in these reactions. Phenolic compounds, common contaminants in water, are quite sensitive to one-electron oxidants to form phenoxy radicals. However, the final products of compounds, common contaminants in water, are quite sensitive to one-electron oxidants to form phenoxy radicals. However, the final products of phenol oxidation are significantly dependent on the substituents of phenol, the type of catalyst, and the reaction conditions employed. GAC, when treated with disinfectants, becomes active in promoting such coupling reactions. All GAC experiments were conducted in a fixed bed, dynamic adsorption system at room temperature. The phenol adsorption was determined by measuring the phenol concentration in the GAC column effluent and mass balance on the whole column. It was found that GAC was able to promote the oxidation of phenol adsorbed from aqueous solution. The product yield was significantly dependent on the reaction pH and the phenol adsorption. The presence of fulvic acid inhibited the formation of phenolic dimers and favored C-O dimer production. (See also W90-06906) (Fish-PTT)

MICROBIOLOGY OF GRANULAR ACTIVATED CARBON USED IN THE TREATMENT OF DRINKING WATER. MONTANA State Univ., Bozeman. Dept. of Microbi-

For primary bibliographic entry see Field 5A. W90-06925

BIODEGRADATION PROCESSES TO MAKE DRINKING WATER BIOLOGICALLY STABLE. Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering. B. E. Rittmann

IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 257-

Descriptors: *Biodegradation, *Biological treatment, *Drinking water, *Water distribution, *Water treatment, Aerobic conditions, Costs, Odors, Stability, Substrates, Taste, Trihalomethanes, Water quality

The presence of biodegradable materials in a drink-ing water can bring about significant problems during treatment and distribution of the water. The presence of biodegradable materials in a drinking water and the common means to forestall its effects water and the common means to forestall its effects (chlorination) have water quality, aesthetic, operational, and economic costs. A drinking water from which nearly all of the biodegradable material has been removed is called biologically stable. The most logical and economical approach to making a water biologically stable is to include a biological treatment process as part of the overall treatment scheme. All biological processes used to make biologically stable drinking water share certain characteristics. Those characteristics are low concentrations of biodegradable material, mixed substrates, predominance of attached biological mass, and aerobic conditions. Biological treatment can and should play an important role in the procan and should play an important role in the pro-duction of a water that is free from biohazards. duction of a water that is free from biohazards. When a water is biologically stable, it is free from organic and inorganic constituents which can biodegrade in the distribution system. This stability means that excessive chlorination need not be practiced, thereby abating the formation of trihalomethanes, TOX, tastes, and odors which are associated with chlorination. (See also W90-06906) (Fish-PTT) W90-06926

NEW HALAMINE WATER DISINFECTANTS. Auburn Univ., AL. Dept. of Chemistry. S. D. Worley, D. E. Williams, S. B. Barnela, and

S. D. Worley, D. E. Whitains, J. L. J. Swango.
IN: Biohazards of Drinking Water Treatment.
Lewis Publishers, Chelsea, Michigan. 1989. p 271-287, 10 fig, 4 tab, 17 ref. U.S. Army Medical Research and Development Command and U.S. Air Force Engineering and Services Center through contract DAMD 17-82-C-2257.

Descriptors: *Chlorinated hydrocarbons, *Disinfection, *Organic compounds, *Water treatment, Air conditioning, Bromine, Chlorine, Cooling towers, Hydrogen ion concentration, Swimming pools, Temperature effects, Toxicity, Trihalomethanes, Water quality.

There is a definite need for a new water disinfect-ant which exhibits long-term stability and does not react appreciably with organic impurities in water to form toxic trihalomethanes. Two classes of compounds, N-halooxazolidinones and N, N'-dihaloi-midazolidinones, which are organic chloramines, were prepared and tested for stability and disinfec-tion efficacy under a variety of conditions of pH, temperature, and water quality. It was concluded that N-halooxazolidinones and N,N'-dihaloimida-zolidinones represent useful new classes of disin-fectants for water applications. The great stability of these compounds renders them particularly useful for disinfection applications for which con-tact time is not of primary importance. Such appli-cations include, but are not limited to, cooling towers, air conditioning systems, swimming pools (particularly winterization), and hot tubs. The compound ABC (1-bromo-3-chloro-4,4,5,5-tetra-methyl-2-imidazolidinone) is recommended as the best for most applications because of its rapid N-halooxazolidinones and N, N'-dihaloimethyl-2-imidazolidinone) is recommended as the best for most applications because of its rapid initial disinfection from the bromine moiety and slower, long-term disinfection from the chlorine moiety. Much toxicity testing employing laborato-ry animals remains to be performed, but the results

of initial testing on poultry were favorable. (See also W90-06906) (Fish-PTT) W90-06928

HYDROGEOCHEMICAL ASSESSMENT OF GROUNDWATER QUALITY IN PARTS OF THE NIGER DELTA, NIGERIA. Port Harcourt Univ. (Nigeria). For primary bibliographic entry see Field 2F. W90-06963

OZONE EQUIPMENT: PROFIT FROM EXPE-

Camp, Dresser and McKee, Inc., Chicago, IL. E. G. Fujikawa, B. T. Farver, and C. M. Robson. Water Engineering and Management WENMD2, Vol. 137, No. 2, p 21-24, February 1990. 1 tab.

Descriptors: *Disinfection, *Ozonation, *Water analysis, *Water treatment, Dewpoint, Drinking water, Giardia, Viruses.

Ozonation is widely used throughout the world as an effective water treatment strategy. A nation-wide survey of 40 water treatment plants using ozonation explores the types of equipment and overall system design that have been used and compares actual operating experiences among the facilities. Ambient air is the raw feed for virtually all U.S. ozonation facilities. There is no clear trend to high-purity oxygen for moderately-sized facilities in the range of 25 to 100 mgd. Newer trends in feed-gas dew points range to -60 C and below, although early U.S. installations had dew points of -40 C or higher. The capacity of individual ozone-generation units in the plants studied ranges from 2 lb/day to 1975 lb/day. Half the ozone contactors were of the single-chamber type. A clear trend is lb/day to 1975 lb/day. Half the ozone contactors were of the single-chamber type. A clear trend is toward multiple stages with longer contact times in facilities being designed for Giardia and virus inactivation. In plants surveyed, determination of ozone gas phase and liquid phase concentration included 13 with gas phase analyzers, 10 with both types. Ten plants use dissolved-ozone probes, and the other eight use colorimetric and/or analytical equipment. (Agostine-PTT)

CONTINUOUS DETERMINATION OF RESID. UAL CHLORITE IN WATER.

Compagnie Intercommunale Bruxelloise des Eaux

M. Denis, G. Minon, and W. J. Masschelein. Analytica Chimica Acta ACACAM, Vol. 226, No. 1, p 121-128, November 1, 1989. 9 fig, 12 ref.

Descriptors: *Chemical treatment, *Disinfection, *Laboratory methods, *Water analysis, *Water treatment, Chlorine, Chlorites, Detection limits, Electrodes, Interference, Oxidation.

Questions relating to the formation and persistence of chlorinated organic compounds in public water distribution systems have encouraged research into alternative techniques to the use of chlorine for disinfection. Chlorine dioxide is a utilizable chemical which does not form trihalomethanes. Its use disinfection. Chlorine dioxide is a utilizable chemical which does not form trihalomethanes. Its use does, however, generate residual chlorite, which has been reported potentially to cause methemoglobinemia when it exceeds admissible concentrations. An analyzer for the continuous monitoring of traces of chlorite ion in water has been developed. The system is based on anodic oxidation in acetate-buffered medium of pH 4.5 and the use of a gold electrode that is conditioned with bromide. For the buffer solutions, acetic acid and sodium acetate were used. Potassium bromide was employed for conditioning of the electrodes. Results showed that the chlorite ion gave a well-defined wave for the anodic oxidation on several gold, platinum, or vitreous carbon electrodes tested, but the sensitivity of the platinum electrode tested, but the sensitivity of the platinum electrode was lower. Drifting, which occurred during measurements of chlorite with gold electrodes, was controlled by the bromide conditioning. No interference was observed from ions such as Ca(2+), Mg(2+), Na(+), K(+), Zn(2+), NO3(-), and ClO(-). The detection limit is 0.05 mg/L and the accuracy is 0.02 mg/L.

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F-Water Treatment and Quality Alteration

It is concluded that the apparatus permits the use of chlorine dioxide in water treatment to be controlled accurately and to be optimized. (Fried-WOOLOKOOD

INNOVATIVE CONTRACT OPERATIONS AGREEMENTS.

Professional Services Group, Inc., Houston, TX. For primary bibliographic entry see Field 5D. W90-07061

PRIVATE OPERATION OF WATER PLANT PAYS DIVIDENDS.

Brockton, MA.
R. D. Smith, S. J. Kruger, and J. C. Muylle.
Public Works PUWOAH, Vol. 121, No. 2, p 52-53, February 1990. 2 fig.

Descriptors: *Brockton, *Chemical treatment, *Cost analysis, *Massachusetts, *Privatization, *Geb Drinking Water Act, *Sedimentation basins, *Water treatment, Algal growth, Alum, Chlorination, Corrosion, Hydrogen ion concentration, *Chudra lancous* Sludge lagoons.

The increasing costs and complexity of water supply and treatment have led city officials to strengthen their efforts to obtain and/or maintain strengthen their efforts to obtain and/or maintain compliance, improve effectiveness, and reduce operations and maintenance costs for municipal water treatment facilities. To lower costs and maintain compliance with more stringent Safe Drinking Water Act regulations, Brockton, Massachusetts contracted out the operations, maintenance and management of its water filtration plant to a private firm. Raw water received at the plant flows into rapid mix basins where chemicals are added: alum for coagulation, caustic soda for pH adjustment, and potassium permanganate for iron and ment, and potassium permanganate for iron and manganese oxidation. From these rapid mix basins, the water flows into flocculating basins where non-ionic polymers are introduced. The water then flows into sedimentation basins from which sludge is pumped to one of two large sludge settling lagoons. Clear water flows into filtering basins algoons. Clear water flows into nitering basins containing activated carbon, percolates through filters into reservoirs where chlorine is added. The activated carbon helps control taste and odor concerns, and controls algal growth. Zinc orthophosphate controls corrosion of the water system. Brockton's water treatment facility is now operating in a cost-effective and efficient manner for a fixed annual fee. (Brunone-PTT)

IRON IN TUBEWELL WATER AND LINEAR GROWTH IN RURAL BANGLADESH. Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrolo-

gie. For primary bibliographic entry see Field 3C. W90-07135

GENOTOXIC EFFECTS OF VARIOUS CHLOR-INATED BUTENOIC ACIDS IDENTIFIED IN CHLORINATED DRINKING WATER.

Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Elintarvikelaboratorio.

L. Tikkanen, and L. Kronberg.
Mutation Research MUREAV, Vol. 240, No. 2, p
109-116, February 1990. 5 tab, 14 ref.

Descriptors: *Chlorination, *Drinking water, *Mutagenicity, *Mutagens, *Water treatment, Bioassay, Chlorine, Chromotest, Salmonella microsome test, Water pollution.

The mutagenic activities of the chlorinated butenoic acids recently identified in chlorinated drinking waters were determined by the Salmonella micro-some assay and by the SOS chromotest. The Sal-monella typhimurium tester strains TA97, TA98 and TA100 were used without and with S9 mix. In the SOS chromotest Escherichia coli PQ37 was used as an indicator organism with and without metabolic activation. In addition, the extremely potent Ames test mutagen (Z)-2-chloro-3-(dichloromethyl)-4-oxobutenoic acid, was studied by the

micronucleus test with mice using intraperitoneal treatment. The results of the Salmonella assay and the SOS chromotest showed that the Ames test mutagen was by far the most potent mutagen of the compounds tested. Mutations were also induced by the reduced form of the Ames test muta-gen, (Z)-2-chloro-3-(dichloromethyl)-4-hydroxyduced by the reduced form of the Ames test mutagen, (2)-2-chloro-3-(dichloromethy)-4-hydroxybut-2-enoic acid, and by the geometric isomer of the Ames test mutagen, (E)-2-chloro-3-(dichloromethy)-4-oxobutenoic acid. However, since the solution of (E)-2-chloro-3-(dichloromethy)-4-oxobutenoic acid contained approximately 5% (Z)-2-chloro-3-(dichloromethy)-4-oxobutenoic acid, most of its activity might be attributable to this Ames test mutagen. The oxidized form of (E)-2-chloro-3-(dichloromethy)-4-oxobutenoic acid, (E)-2-chloro-3-(dichloromethy)-butenedioic acid, (E)-3-chloro-3-(dichloromethy)-butenedioic acid, (E)-3-chloromethy-butenedioic acid, (E)-3-chloro-3-(dichloromethy)-butenedioic acid, (E)-3-chloromethy-butene marginally active in the SOS chromotest only. All these compounds were directly acting mutagens and in the presence of metabolic activation (S9 mix) they did not generate mutagenicity. The oxidized form of the Ames test mutagen, (Z)-2-chloro-3-(dichloromethyl)-butenedioic acid, was not mutagen at the dose levels tested. The Ames test mutagen did not induce micronuclei in the bone marrow of mice. (Author's abstract) W90-07178

REVIEW OF THE ROLE OF THE PHYSICO-CHEMICAL ENVIRONMENT IN THE PRO-DUCTION OF CERTAIN FLOC PROPERTIES. Kansas State Univ., Manhattan. Dept. of Chemical Engineering.

L. A. Glasgow, and Y. H. Kim. Water, Air and Soil Pollution WAPLAC, Vol. 47, No. 1-2, p 153-174, September 1989. 10 fig, 51 ref. NSF grant CPE-841191.

Descriptors: *Flocculation, *Literature review, *Wastewater treatment, *Water treatment, Coagu-lation, Hydrodynamics, Hydrogen ion concentra-tion, Physicochemical properties.

The aggregation of suspended particles in water and wastewater treatment processes is one of the oldest practices in solid-liquid separation. However, most treatment operation at least occasionally experience poorly settling flocs or extensive deagregation. The present state of knowledge regarding the effects of the process environment on floc characteristics is reviewed. Fluid motion has little impact on the size-density relationship. In contrast, floc density is profoundly affected by pH and ionic strength. The influence of hydrodynamics upon floc strength is uncertain, but probably weighs upon the functioning of some coagulating agents depending upon the characteristic time of coagulant-particle interaction. It is possible that the energetics of the collision process also affect the extent The aggregation of suspended particles in water getics of the collision process also affect the extent of interparticle binding or affiliation, with lowenergy events producing limited ties between the participants. The impact of hydrodynamics upon size is profound, with constraints imposed by the distribution of turbulent energy with respect to eddy scale and the nature of structures formed at eddy scale and the nature of structures formed at lower levels of aggregation. The impact of process chemistry upon permeability is enormous for kaolin-anionic polymer flocs due to changes in macromolecular conformation. This is particularly evident for pH 9.5. Light transmission/obscuration can be used to gauge growth rate, floc size, and floc density by transient experiments; the effects of changes in process chemistry are readily detected by such monitoring. The effect of the process environment upon fractal dimensions may be sig-nificant but insufficient data exist at this time to establish any generally applicable criterion. The optimization of coagulation processes would entail the production of aggregates specifically tailored for process objectives and constraints. This is impossible given the present level of understanding of possible given the present level of unucrosamum, on how floc characteristics are determined by the interactions of hydrodynamics, process chemistry, and collisional mechanisms. (Sand-PTT)

COMPLYING WITH THE NEW DRINKING

WATER QUALITY REGULATIONS.
American Water Works Association, Denver, CO.
For primary bibliographic entry see Field 5G.
W90-07326

MCI. NONCOMPLIANCE: IS THE LABORA-TORY AT FAULT.

Hunton and Williams, Richmond, VA.

S. J. Koorse Journal of the American Water Works Association JAWWA5, Vol. 82, No. 2, p 53-58, February 1990. 3 tab. 29 ref.

Descriptors: *Compliance, *Laboratories, *Safe Drinking Water Act, *Water analysis, Administrative regulations, Comparison studies, Environmental Protection Agency, Performance evaluation, Practical quantitation level, Statistics.

The role of the laboratory in the Safe Drinking Water Act (SDWA) regulatory process has been grossly underestimated. Under the SDWA, the laboratory must develop maximum contaminant levels (MCLs) and determine compliance. The 1986 amendments to SDWA results the FPA to levels (MCLs) and determine compliance. The 1986 amendments to SDWA require the EPA to promulgate MCLs for 83 contaminants by 19 June 1989 and for at least 25 additional contaminants by 1 January 1991. The EPA develops MCLs based on three considerations: (1) removal capabilities of available technologies, (2) cost of available technology, and (3) analytical methods available for measuring the constituents it seeks to regulate. The laboratory is central to the last of these three elements. The performance of available analytical methods for a given contaminant is described by the practical quantitation level (PQL), which is the lowest concentration that can be reliably measured with specified limits of precision and accuracy during routine laboratory operating conditions. If with specified limits of precision and accuracy during routine laboratory operating conditions. If the PQL is higher than the MCL goal for a given contaminant, the PQL becomes the limiting factor in setting the MCL. EPA derives PQLs by calculation for interlaboratory performance authorities. tion for interlaboratory performance evaluation data or, if such data are not available, from estimadata or, if such data are not available, from estimation by a rule-of-thumb technique. The way the EPA is implementing SDWA has elevated radically the laboratory's influence over the ability of a water system to comply with EPA's drinking water regulations. Statistically, when a contaminant is known to be present at the MCL, the laboratory is expected to produce results above the MCL half of the time. Although EPA recognizes the existence of this margin of error, it is not considered in setting the requirements for compliance, which are at or below MCL 100% of the time. This means that a water system will experiance, which are at or below MCL 100% of the time. This means that a water system will experience MCL violations entirely as a result of laboratory errors even if its water is within acceptable limits. Several techniques of analysis, data presentation, and laboratory management are available to help cope with this problem. (Rochester-PTT) W90-07327

STANDARDS OF MINERAL CONTENT IN DRINKING WATER.

California Univ., Berkeley. School of Public Health. W. H. Bruvold, and J. I. Daniels.

Journal of the American Water Works Association JAWWA5, Vol. 82, No. 2, p 59-65, February 1990. 1 fig, 8 tab, 29 ref.

Descriptors: *Cost analysis, *Dissolved solids, *Drinking water, *Organoleptic properties, *Standards, *Taste, American Water Works Association, Attitudes, California Mineral Taste Study, Comparison studies, Environmental Protection Agency, Mineral water.

The American Water Works Association Statement of Policy on Drinking Water Quality and the Environmental Protection Agency (EPA) standard for total dissolved solids (TDS) in drinking water are reviewed. Data from the California Mineral Taste Study (CMTS) indicate that for mineral content a TDS of 450 mg/L will result in good quality water and a TDS of 80 mg/L will result in excellent quality water. lent quality water. A cost comparison between systemwide demineralization and the purchase of bottled water by individual consumers shows that systemwide demineralization may be less costly to the residential consumer. Such cost information, when developed for a particular utility, can be presented to the community and used in making an informed decision on systemwide water treatment to reduce TDS. This type of study and presentation should be done by any utility having more than 500 mg/L TDS. (Rochester-PTT) W90-07328

REMOVING RADIUM BY ADDING PRE-FORMED HYDROUS MANGANESE OXIDES, Iowa Univ., Iowa City. Dept. of Civil and Envi-ronmental Engineering. R. L. Valentine, K. M. Spangler, and J. Meyer. Journal of the American Water Works Association JAWWAS, Vol. 82, No. 2, p 66-71, February 1990. 9 fig, 1 tab, 37 ref.

Descriptors: *Chemical treatment, *Decontamina-tion, *Radium radioisotopes, *Water treatment, Cost analysis, Hydrogen ion concentration, Isoth-erms, Manganese oxides, Performance evaluation,

Batch and field pilot-scale studies were conducted Batch and field pilot-scale studies were conducted of a radium removal process involving the addition of relatively small amounts of preformed hydrous manganese oxides (HMOs). Several different chemical systems were used to preform the HMOs, which were applied either continuously or periodically. Only 226Ra removal was evaluated in all the experiments because the chemical behavior of cally. Only 226Ra removal was evaluated in all the experiments because the chemical behavior of 228Ra is identical. Batch experiments were used to quantify radium sorption as a function of several parameters, including pH and HMO dosage, and to develop a radium removal isotherm. The field pilot-scale studies evaluated removals under controlled conditions intended to mimic realistically an actual water treatment plant. The addition of preformed HMOs appears to be technically feasible as demonstrated by both types of experiments. Major advantages of the process include reliance on existing treatment facilities and simplicity of operation. In addition, no irreversible effects are expected if the HMOs are underdosed or overdosed, with the possible exception of inadequate radium removal or shortened filter runs resulting from the breakthrough of solids. Both the capital and operating costs associated with this technology are expected to be relatively low. (Rochester-PTT) W90-07329

ADSORPTION CAPACITY OF GAC FOR SYN-THETIC ORGANICS. Environmental Protection Agency, Cincinnati,

OH

OH.
T. F. Speth, and R. J. Miltner.
Journal of the American Water Works Association
JAWWA5, Vol. 82, No. 2, p 72-75, February 1990.
3 fig. 1 tab, 10 ref.

Descriptors: *Activated carbon, *Adsorption kinetics, *Granular activated carbon, *Herbicides, *Organic compounds, *Pesticides, *Raw water, *Water treatment, Environmental Protection Agency, Great Miami Aquifer, Groundwater, Isotherms, Ohio, Ohio River, Safe Drinking Water Act, Surface water.

Isotherms play a major role in the design of carbon adsorption systems. Models of carbon adsorption all require as inputs equilibrium data obtained from isotherm experiments. Since 1981 the Environmental Protection Agency has been conducting iso-therm experiments for many of the compounds therm experiments for many of the compounds cited in the 1986 amendments to the Safe Drinking Water Act. Isotherms determined in these studies are listed here for 58 compounds in distilled-deion-ized (DD) water, filtered Ohio River water, and filtered groundwater (Great Miami Aquifer, Ohio). These compounds include, both chlorinated and non-chlorinated aromatics, chlorinated and bronon-chlorinated aromatics, chlorinated and bro-minated aliphatics, chlorinated insecticide, carba-mates, as well as triazine herbicides. Data present-ed include the number of data points in the deter-mination, range of liquid-phase concentration at equilibrium (microgram/L), Freundlich constants (K, 1/n), and 95% confidence intervals for the two Freundlich constants. The natural water isotherms generally had reduced capacity compared to the DD water isotherms. For a few natural water isotherms, individual isotherm points showed a higher capacity than that of the DD water isotherms. erms. In these cases, the confidence intervals around the individual isotherm points for both isotherms overlapped one another. (RochesterW90-07330

CHEMISTRY OF MUTAGENIC BY-PROD-UCTS OF WATER CHLORINATION.

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering. L. Kronberg, and R. F. Christman. Science of the Total Environment STENDL, Vol. 81/82, p 219-230, June 1989. 5 fig, 1 tab, 27 ref.

Descriptors: *Chlorination, *Disinfection, *Mutagens, *Water treatment, Byproducts, Chlorine, Degradation, Drinking water, Mutagenicity.

The strong Ames mutagen 3-chloro-4-(dichloromethyl)5-hydroxy-2(5H)-furanone (MX) and its geometric isomer E-2-chloro-3-(dichloromethyl)4-be present in chlorinated drinking waters. MX accounts for approximately 30% and E-MX for a few percent of the overall mutagenicity. MX and E-MX are unstable in water and undergo both pH dependent isomerization and hydrolytic degradation. Alternative methods of disinfection have been found to produce mutagenicity, and MX and E-MX but to a lesser extent than disinfection with chlorine. The MX analogues 3-chloro-4-(dichloromethyl)-2(5H)-furanone (red-MX) and 2-chloro-3-(dichloromethyl)-2-butenedioic acid (ox-MX) have also been identified in chlorinated water. However, the relatively low mutagenicity of these comalso been identified in cinofinated water. However, the relatively low mutagenicity of these compounds suggests that their contribution to the overall mutagenicity of chlorinated water is of only moderate significance. (Author's abstract) W90-07373

FORMATION OF CHLORINATED PAH: A POSSIBLE HEALTH HAZARD FROM WATER CHLORINATION.

CHLORINATION.
Institutt for Kontinentalsokkelundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). S. Johnsen, I. S. Gribbestad, and S. Johansen. Science of the Total Environment STENDL, Vol. 81/82, p 231-238, June 1989. 1 fig, 2 tab, 16 ref.

Descriptors: *Aromatic compounds, *Chlorinated hydrocarbons, *Chlorination, *Mutagenicity, *Water treatment, Byproducts, Chlorine, Disinfection, Mutagens, Organic matter.

Four polycyclic aromatic hydrocarbon (PAH) compounds, fluorene, anthracene, fluoranthene and benzo(a)pyrene were dissolved in humus poor (lake) and humus rich water. The samples were chlorinated, stored for three days, and extracted with cyclohexane. Chlorinated derivatives of the four compounds were synthesized and used as calibration standards for quantitative analysis of the corresponding chlorinated PAH formed during the experiment. The synthesized chlorinated PAH the experiment. The synthesized chlorinated PAH were tested for mutagenic activity by the Ames test, and their octanol/water partition coefficient (Pow) were determined by thin layer chromatography. Chlorinated fluorene, fluoranthene and benzo(a)pyrene were formed during chlorination of PAH polluted lake water, but not during chlorination of the humus rich water samples. All chlorinated PAH except 9,10-dichloroanthracene acted as strong mutagens both in the presence and in the absence of metabolic activation, while as strong mutagens both in the presence and in the absence of metabolic activation, while benzo(a)pyrene was the only mutagen active parent PAH. The determined Pow showed high lipophilicity for all chlorinated PAH. Theoretically determined bioconcentration factors (BCF) were found to be extremely high, and increased with increasing ring number and increasing number of chlorine atoms attached to the ring. (Author's abstract)

ANION EXCHANGE AS A POTENTIAL METHOD FOR REMOVAL OF HUMUS IN DRINKING WATER TREATMENT. National Inst. of Public Health, Oslo (Norway).

D. Hongve. Science of the Total Environment STENDL, Vol. 81/82, p 249-256, June 1989. 2 fig, 2 tab, 13 ref.

Descriptors: *Anion exchange, *Humic substances, *Organic matter, *Water treatment, Dissolved

solids, Norway, Organic carbon, Separation techniques

Removal of humus by anionic exchange is a potential process for small waterworks in Norway. The interaction between humic substances and a strong base anion exchange resin was studied and the results are used for characterization of the humic substances. Thirty percent of the organic matter as removed from the water during the first six seconds of contact with the resin. This fraction had a higher negative charge and lower molecular weight than the average for the water sample. With increasing contact time, fractions with a decreasing charge density and increasing color and molecular weight were removed. The unobserved dissolved organic carbon fraction had a net positive charge. The anion exchange process results in a reduction in pH, and dissolved iron and aluminum are transformed from organic complexes to inorganic species. This may represent an obstacle for the practical use of the process. (Author's abstract) abstract) W90-07376

TRACE ANALYSIS OF VOLATILE CHLORIN-ATION BYPRODUCTS OF AQUATIC HUMIC SUBSTANCES: THMS IN TREATED WATER.

SUBSTANCES: THMS IN TREATED WATER. National Centre for Scientific Research, Havana (Cuba). Chemistry Div. L. Gonzalez, M. Lorenzo, and L. Valdes. Science of the Total Environment STENDL, Vol. 81/82, p 257-270, June 1989. 9 fig. 3 tab, 15 ref.

criptors: *Chlorination, *Humic substan Pollutant identification, *Triume substances, *Pollutant identification, *Trihalomethanes, *Water treatment, Byproducts, Disinfection, Organic acids, Separation techniques.

A purge and trap technique was tested for the isolation/concentration of trihalomethanes (THMs) in treated water. The new method was (THMs) in treated water. The new method was employed during one year of operation in a filtration plant where prechlorination is applied to control the occurrence of iron and manganese compounds in finishing water and reduce algal growth. The method detection limit using direct thermal desorption/cryofocusing condition/capillary/mass spectrometry system (DTDC/GC/MS) was 50-74 micrograms/L for chloroform and 0.48 micrograms/L for bromoform. The values of the method detection limit using GC/DTDC with flame ionic detection (at attenuation 8.10), were 0.47 microdetection (at attenuation 8.10), were 0.47 microdetection limit using GC/DIDC with liame ionic detection (at attenuation 8.10), were 0.47 micrograms/L (chloroform) and 20 micrograms/L (valuations showed that the treated water contained the main haloforms, from chloroform to bromoform, at decreasing concentrations. The terminal THM at decreasing concentrations. The terminal IHM concentrations were, in general, at similar levels after chlorination, after sedimentation, in potable water supplies and in tap water. Higher terminal chloroform concentration found during March, October and November could be explained by October and November could be explained by dissolved precursors in raw water. Since the evolution of THMs during water treatment is rather complex, characteristics such as total organic carbon, dissolved organic carbon, and other oxidation alternatives to chlorine should be examined. (Geiger-PTT) W90-07377

HUMIC SUBSTANCE REMOVAL THROUGH SURFACE WATER POTABILIZATION PROC-

National Centre for Scientific Research, Havana

(Cuba). Chemistry Div.
L. A. Fernandez, M. Bataller, R. Perez, L.
Gonzalez, and J. Molerio.

Science of the Total Environment STENDL, Vol. 81/82, p 271-278, June 1989. 2 fig. 2 tab, 13 ref.

Descriptors: *Chlorination, *Humic substances, *Trihalomethanes, *Water treatment, Activated carbon, Coagulation, Filtration, Flocculation, Organic compounds, Ozonation, Sedimentation, Separation techniques.

Chlorination of natural waters during water treat-ment processes produces trihalomethanes (THM) as well as other higher molecular weight haloge-

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F-Water Treatment and Quality Alteration

nated organic compounds, presumably through reactions with humic substances present in natural waters (THM precursors). The removal of humic waters (IHM precursors). In eremoval or nume substances was achieved by using a laboratory-scale surface water ozonation pretreatment process. Monitoring of precursors removal was achieved by adding excess amounts of chlorine to water samples taken through the process, and then measuring THM formation via a purge-and-trap of volatiles, concentration, and gas-liquid chromatographic analysis. It was demonstrated that both preozonation followed by coagulation-floculation-sedimentation, and activated carbon filtration. remove important amounts of THM precursors.
On the other hand, filtration through inert media (sand, anthracite) do not exert a significant influ-ence on THM precursors content of water. These results support the idea of the humic nature of THM precursors. (Author's abstract) W90-07378

MUTAGENIC ACTIVITY AND PRESENCE OF THE STRONG MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2-(5H)-FURANONE (MX) IN CHLORINATED RAW AND DRINKING WATERS IN THE NETHER-

Abo Akademi, Turku (Finland). Dept. of Organic Chemistry.

For primary bibliographic entry see Field 5C. W90-07400

USE OF U.Y. RADIATION IN WATER TREAT-MENT: MEASUREMENT OF PHOTONIC FLUX BY HYDROGEN PEROXIDE ACTINO-METRY (UTILISATION DU RAYONNEMENT ULTRAVIOLET DANS LE TRAITEMENT DES EAUX: MESURE DU FLUX PHOTONIQUE PAR ACTINOMETRIE CHIMIQUE AU PER-OXYDE D'HYDROGENE).

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.

I. Nicole, J. De Laat, M. Dore, J. P. Duguet, and

C. Bonnel. Water Research WATRAG, Vol. 24, No. 2, p 157-168, February 1990. 14 fig, 7 tab, 22 ref. English

Descriptors: *Organic pollutants, *Oxidation, *Ul-traviolet radiation, *Water treatment, Hydrogen peroxide actinometry, Kinetic equations, Optical density, Photochemical reactors.

Advanced oxidation processes involving the generation of hydroxyl radicals or other reactive entities by the combination of ultraviolet (UV) radiation and a chemical oxidant (ozone or hydrogen peroxide) have been shown to be effective for the degradation of organic micropollutants resistant to classical oxidants. However, comparison of results of photochemical/oxidative degradation-rate studies is difficult because of the great diversity of photochemical reactors used and the lack of data about the characteristics of UV light sources (phoabout the characteristics of UV fight sources (photonic fluxes). Experiments were carried out in various photochemical reactors equipped with a low-pressure mercury-vapor lamp. In such reactors, the degradation of hydrogen peroxide arises essentially from the absorption of incident radiation at 253.7 nm. If no reflection occurs (reactors made of non-reflecting walls or high values of internal optical results obtained in this study showed that the photolysis rate of hydrogen peroxide obeys the general kinetic equation. For high values of optical density of the hydrogen peroxide solution (concentrated medium), the photonic fluxes of the lamps agreed with those obtained by potassium ferrioxalate or uranyl oxalate actinometry and confirm that the incident photonic flux at 253.7 nm of the two UV lamps used is about 70-80% of the total photonic flux. Compared with potassium ferrioxalate or uranyl oxalate actinometry, the utilization of hydrogen peroxide as an actinometer is an attrac-tive method for the determination of incident photonic flux and for the evaluation of the reflecting power of the internal wall of photochemical reactors. These reflecting properties must be taken into account in the kinetic equations of photochemical reactions and for the optimization of photochemical reactors. (Shidler-PTT)

FIXED-BIOFILM REACTORS IN AQUACUL-TURAL WATER RECYCLE SYSTEMS: EFFECT OF ORGANIC MATTER ELIMINATION ON NITRIFICATION KINETICS.

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control. For primary bibliographic entry see Field 5D. W90-07422

KINETICS OF INACTIVATION OF GIARDIA LAMBLIA BY FREE CHLORINE, Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, and B. Heller.
Water Research WATRAG, Vol. 24, No. 2, p 233-

238, February 1990. 6 tab, 19 ref.

Descriptors: *Chlorination, *Disinfection, *Giardia. *Water treatment, Free chlorine, Hom model, Hydrogen ion concentration, Model studies, Tem-

Experimental data on the inactivation of Giardis cysts by free chlorine was analyzed by the method of maximum likelihood. It was found that the Hom model with a model constant (m) value less than 1 model with a model constant (m) value less than i (indicative of 'tailing off') more precisely charac-terized the inactivation than the Chick-Watson model. The Hom model was found to fit the data using a Monte Carlo procedure to obtain the sam-pling distribution of the log likelihood statistic. The jackknife procedure was used to produce in-The jackstime procedure was used to produce in-terval estimates for inactivation rate parameters and ct values at various concentrations, tempera-tures, pH values and degrees of inactivation. The ct values increase as concentration increases due to coefficients of dilution less than one. The computed ct values are generally lower, and particularly at 2-3 logs inactivation substantially lower, than those previously estimated from the same data. The difference is attributed to the manner in which In conference is attributed to the manner in which results from 1 to 4 (of 5) animals were lumped and interpreted as arising from 4 logs inactivation. At both 2.5 and 5 degrees C, there is a consistent increase in the required ct value with pH. However at 0.5 degrees C, the ct values at pH 8 are less er at U.5 degrees C, the ct values at ph 18 are less than those required at pH 7, contrary to anticipated. At pH 6, there is a consistent decrease in required ct values as temperature increases. However at pH 7 and pH 8, the effect of temperature is more irregular. Due to the apparent anomalies in the pH and temperature dependence of the ct values no procedure for extrapolation of the inactivation results outside the range of conditions used can be recommended. (Author's abstract)

BIOFILM DEVELOPMENT ON STAINLESS STEEL AND PVC SURFACES IN DRINKING WATER

Goeteborg Univ. (Sweden). Dept. of Marine Microbiology.

K. Pedersen. Water Research WATRAG, Vol. 24, No. 2, p 239-243, February 1990. 2 fig, 2 tab, 25 ref.

Descriptors: *Artificial substrates, *Biofilms. *Drinking water, *Microorganisms, Growth, Hydrophilic surface, Hydrophobic surface, Lead, Polyvinyl chloride, Protozoa, Stainless steel

Surfaces of electro-polished, bright annealed and matt stainless steel and of lead stabilized PVC (polyvinyl chloride) were exposed to running municipal drinking water (10 cm/s) for 167 days. The total number of micro-organisms growing on the surfaces was examined with an acridine orange surfaces was examined with an acridine orange direct count technique at 7 sampling times. The growth was exponential with a doubling time of 11 days between 0-122 days which increased to 47 days between 123-167 days. The mean number of nicro-organisms on the surfaces after 167 days was micro-organisms on the surfaces after 167 days was 4,900,000 cells/sq cm. There was no difference in the amount of cells on the hydrophilic glossy steel surfaces and the hydrophobic PVC surface. The biofilm processes of growth, product formation and debris entrapment seemed to dominate over the initial surface energy dependent attachment processes. The matt steel surface is rougher than the other surfaces and had an average of 4,070,000 bacteria/sq cm during the last 45 days, which is

1.44 times more micro-organisms than the electro-polished steel had. Two reasons support this obser-vation. Detachment due to shear forces from the flow will be reduced on the rougher surface since the cells can be shielded from the bulk flow and more substratum surface area may be available for the biofilm. Micro-flagellates were grazing the bacteria on the test surfaces after 122 days. This might explain why the doubling time decreased to 47 days between 123-167 days. It suggests that microbial biofilms in drinking waters are grazed and thereby partly controlled by protozoa. (Author's abstract)

HUMIDITY WATER VAPOUR COLLECTION BY ABSORPTION COOLING MACHINES. King Abdulaziz Univ. Jeddah (Saudi Arabia). Dept. of Mechanical Engineering. For primary bibliographic entry see Field 3B. W90-07440

RECARBONATION PROCESS FOR TREAT-MENT OF DISTILLED WATER PRODUCED BY MSF PLANTS IN KUWAIT.

Ministry of Electricity and Water, Safat (Kuwait). H. E. Al-Roobah, and A. Al-Munayyis. Desalination DSLNAH, Vol. 3, No. 1/3, p 295-Desalination DSLNAH, vol. 3, 130. 312. November 1989. 9 fig, 3 tab, 4 ref.

Descriptors: *Desalination, *Distilled water, *Kuwait, *Multistage flash evaporation, *Recarbonation, *Taste, *Water treatment, Acidification, Carbon dioxide, Carbonation, Drinking water, Hydrogen ion concentration, Limestone.

Distilled water produced from multistage flash (MSF) plants is a very soft water that has a low buffer capacity. As such, it is considered quite aggressive to the materials encountered in the water distribution system. Furthermore, this unreated water is not acceptable from a palatability treated water is not acceptable from a palatability point of view. Different remedial treatment processes are therefore being adopted by MSF plants. In Kuwait, a recarbonation process has been in operation for 18 months at Shuwaikh Desalination Plant treating 18 million gallons per day (MGD) of distilled water as the first step in a major scheme aimed at treating water produced by all MSF plants in Kuwait. The major steps in the adopted recarbonation process include: (1) the extraction of carbon dioxide from the vent gas system of the MSF plant; (2) compression and purification of the CO2-air gas stream; (3) acidification of a pre-calculated distilled water stream in a gas absorption CO2-an gas stream; (3) adultication of a pre-catediated distilled water stream in a gas absorption tower; (4) limestone dissolution to augment the water with Ca(2+) and HCO3(-) necessary for water to be self-inhibiting; (5) degasification of the excess CO2; (6) blending with by-passed distilled water; and (7) pH adjustment. The operating data, over a period of 12 months, indicated that the Shuwaikh Recarbonation Plant, built for the treatment of 18 MGD of distilled water, has fulfilled its objectives. The plant has smooth and stable operat-ing characteristics. Based on the experience gained and the overall outcome of this process, Ministry of Electricity has decided to build two recarbona-tion plants. The first one at Doha, with a capacity of 90 MGD and the second one at Az-Zour with a capacity of 40 MGD. After implementing this scheme, all distilled water produced in Kuwait will be recarbonated in an attempt to overcome the problem of 'red water'. (Lantz-PTT) W90-07450

5G. Water Quality Control

ESTIMATING THE NUMBER OF SPECIES AND RELATIVE ABUNDANCE OF FISH IN OLIGOTROPHIC SWEDISH LAKES USING MULTI-MESH GILLNETS.

Institute of Freshwater Research, Drottningholm (Sweden).
E. Degerman, P. Nyberg, and M. Appelberg.
Nordic Journal of Freshwater Research, No. 64, p
91-100, 1988. 8 fig, 2 tab, 39 ref.

Descriptors: *Acid rain effects, *Fish management, *Gill nets, *Monitoring, *Species diversity,

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*Sweden, *Water pollution treatment, Acid lakes, Aquatic populations, Fish, Lakes, Oligotrophic lakes, Perch.

In 1983 a monitoring program was initiated to study the long-term effects of freshwater liming on fish populations in Sweden. The program's main objectives were to assess the population changes on a whole-lake basis, give estimates of the number on a whole-lake basis, give estimates of the number of species present, sample length frequencies and also to estimate the relative abundance and growth of the dominating species. Data from 133 test-fished oligotrophic, acidified and limed Swedish lakes have been used to estimate the number of gill nets needed to catch all catchable fish species and to estimate the relative abundance of dominating species. The test-fishing was depth stratified using benthic and pelagic, multi-mesh gill nets. The number of randomly set benthic gillnets required to catch all catchable fish species increased with lake area, for example, 5 randomly set benthic gill net were needed to catch all fish species in lakes with an area of 100 ha. The catch per unit effort was transformed using Log (CPUE effort + 1) to dissociate the variances and the means. The number of nets required to attain a certain precision in the estimate of the catch per unit effort for sion in the estimate of the catch per unit effort for dominating fish species was calculated. The number of nets required increased with lake area number of hets required interased with nake area for perch, but not for other dominating species. Depth stratified sampling considerably increased the precision of the whole-lake catch per unit effort of dominating species. (Mertz-PTT) W90-06601

SEQUENTIAL DECISION PLANS, BENTHIC MACROINVERTEBRATES, AND CAL MONITORING PROGRAMS. California Univ., Berkeley. Dept. of Entomologi-For primary bibliographic entry see Field 5A. W90-06609

METHOD FOR PREDICTION OF EXTENT OF MICROBIAL POLLUTION OF SEAWATER AND CARRYING CAPACITY OF BEACHES. Bogazici Univ., Istanbul (Turkey). Dept. of Chemi-For primary bibliographic entry see Field 5B. W90-06610

EFFECT OF HYDROCARBONS AND DECON-TAMINATING SUBSTANCES ON BACTERIAL FLORA OF COASTAL SEDIMENTS.

Istituto Sperimentale Talassografico, Messina For primary bibliographic entry see Field 5C. W90-06630

IDENTIFYING TOXICANTS: NETAC'S TOXIC-ITY-BASED APPROACH.
National Effluent Toxicity Assessment Center, For primary bibliographic entry see Field 5A. W90-06662

POLLUTION OF HARBOUR SEDIMENTS BY HEAVY METALS.

Antwerpse Waterwerken (Belgium).

Ocean and Shoreline Management OSMAE6, Vol. 12, No. 5/6, p 463-475, 1989. 3 tab, 2 fig, 29 ref.

Descriptors: *Cleanup operations, *Dredging, *Harbors, *Heavy metals, *Sediment contamination, *Waste disposal, *Water pollution control, Sediments, Soil amendments, Water pollution.

Dredging is normally the best solution to counter-act sedimentation in harbors. Planning dredging operations requires a study of the distribution, thickness, type and origin of the sediments. Sam-pling and analysis of the deposits, especially with regard to heavy metal contents, is necessary to decide about their use in agriculture or about other methods of disposal. A follow-up study of the soils enriched with sediments and of the sediments in situ is always necessary. (Author's abstract) situ is always necessary. (Author's abstract)

DEVELOPMENT OF THE REVISED DRINK-ING WATER STANDARD FOR CHROMIUM. ING WATER STANDARD FOR CHROMIUM. Environmental Protection Agency, Washington, DC. Office of Drinking Water. S. Goldhaber, and C. Vogt. Science of the Total Environment STENDL, Vol. 86, No. 1/2, p 43-51, Oct 1 1989. 2 tab, 5 ref.

W90-06687

Descriptors: *Administrative regulations, *Chromium, *Public health, *Water quality standards, Administrative agencies, Drinking water, Legislation, Water quality.

The United States Environmental Protection Agency (EPA), under the authority of the Safe Drinking Water Act, is developing comprehensive regulations to limit human exposure to contaminaregulations to limit human exposure to contamina-tion in drinking water. These regulations are being developed in several phases and deal with synthetic organic chemicals, incrganic chemicals, micro-biological contaminants, and radionuclides. The agency is to establish maximum contaminant levels (MCLs) as close to the MCLGs as feasible. MCLGs are non-enforceable health goals; MCLs are the enforceable standards. The current MCL for chromium under the National Interior Primary. are the enforceable standards. The current MCL for chromium, under the National Interim Primary Drinking Water Regulations, is 50 micrograms/L for total chromium. The EPA is proposing to set an MCLG for total chromium based on the toxicology of Cr(VI). Chromium has been classified as a probable human carcinogen, based upon evidence that Cr(VI) causes lung cancer in humans and animals through inhalation exposure. The EPA is proposing to set the MCL for chromium equal to the MCLG (100 micrograms/L) since this level has been determined to be feasible based upon the following analysis: (1) there are currently-available technologies for chromium removal (reverse osmosis, ion exchange, coagulation, and lime softening) and they have been installed in public water supplies and are compatible with other water-treatment processes in different regions of the US; (2) analytical methods (the atomic-absorpthe US; (2) analytical methods (the atomic-absorp-tion furnace and inductively-coupled plasma tech-niques) are available for the analysis of chromium in drinking water; (3) The practical quantitation level, the lowest concentration that can be reliably neasured during routine laboratory operating con-ditions, is below the proposed MCL of 100 micro-grams/L-thus, it is feasible to routinely analyze for chromium in drinking water; (4) the MCLG of 100 micrograms/L for chromium is greater than the maximum occurrence level for the compound; and (5) the national costs of complying with the proposed MCL approach zero. (Male-PTT) W90-06698

SCREENING AT MARINE OUTFALL HEAD-WORKS.

For primary bibliographic entry see Field 5D. W90-06711

WATER SOURCE PROTECTION AND PRO-

TECTION ZONES.
M. B. M. Harryman.
Journal of the Institution of Water Engineers and
Scientists. JIWSDI, Vol. 3, No. 6, p 548-550, De-

Descriptors: *Nitrates, *Water policy, *Water pollution prevention, *Water zoning, England.

This paper discusses government policy to August 1989 on the use of protection zones to protect UK water sources from pollution by nitrate. It outlines the use of the powers in the Water Act 1989 to declare Nitrate Sensitive Areas, and the procedures that would be followed in declaring such zones. The circumstances are outlined in which compensation would be paid in Nitrate Sensitive Areas and the resease for denerting from the ited. compensation would be paid in Nitrate Sensitive Areas and the reasons for departing from the 'polluter pays' principle. There are similarities of approach between the UK's policy for control of nitrate and the controls being proposed by the European Community. Community policy will also rely upon protection at source through restrictions. In general the UK favors a pragmatic ap-

proach to nitrate control. The UK policy places more emphasis than that proposed by the European Commission on adopting solutions that are appropriate in different areas. Further details of the UK policy on nitrate control will be announced soon and the government expects to introduce measures in advance of the EC Directive coming into effect. (Sand-PTT) W90-06712

ELIMINATION OF PENTACHLOROPHENOL POLLUTION FROM THE FORTH CATCHMENT.

For primary bibliographic entry see Field 5A. W90-06720

RAW WATER QUALITY CONTROL: AN OVERVIEW OF RESERVOIR MANAGEMENT TECHNIQUES.

Ecosystem Consulting Service, Inc., Coventry,

R. W. Kortmann

Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 4, p 197-220, December 1989. 14 fig, 23 ref.

Descriptors: *Reservoir operation, *Reviews, *Water quality control, *Watershed management, Aeration, Algicides, Costs, Erosion control, Pretreatment of water, Water treatment.

The quality of water which enters a treatment plant has a direct effect on dosage rate for flocculation, filtration run time, granular activated carbon bed longevity, Trihalomethane formation potential, and finished water quality. Reservoir management can reduce chemical and operations cost and the need for chemical algicide application, which has both economic and environmental advantages. Surface water supply systems are often a complex array of watershed subbasins, diversions, storage reservoirs, and delivery reservoirs. A com-prehensive evaluation of individual system compoprenensive evaluation of indivioual system compo-nents and the relationships to water quality param-eters in the treatment sequence often leads to iden-tification of a 'best management approach' for an individual supply system. The applicability of the following approaches is discussed: Agricultural 'BMPs'; Wetland Renovation; Stormwater Manionowing approaches is decision. Agricultural BMPs'; Wetland Renovation; Stormwater Management Techniques; Sediment and Erosion Control; Regulatory Methods; Flowstage Selection, Enhanced Interflow; Pretreatments; Destratifica-Enhanced Interflow; Pretreatments; Destratifica-tion-Circulation; Hypolimentic Aeration; Layer Aeration; Depth-Selective Releases; Reservoir Blending and Sequencing; Nutrient Inactivation; Thermal Partitioning; Depth-Selective Withdraw-al; Destratification (full/partial); Hypolimnetic and Layer Aeration; Nutrient Inactivation; Algicide Focusing; and 'Front End Treatment Scheme Ad-ditions'. (Author's abstract) W90-06728

MANAGEMENT AND POLICY EFFECTS ON POTENTIAL GROUNDWATER CONTAMINA-TION FROM DAIRY WASTE.

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
C. D. Heatwole, P. L. Diebel, and J. M. Halstead. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 25-34, February 1990. 3 fig. 4 tab, 16 ref. US Geological Survey, Department of the Interior under Award No. 14-08-001-1301.

Descriptors: *Dairy wastes, *Farm wastes, *Groundwater pollution, *Nitrates, *Water pollution control, Economic aspects, Model studies,

A combined economic and water quality modeling framework was used to evaluate impacts of alternative policies and management practices on re-ducing nitrate movement to groundwater for dairy farms in Rockingham County, Virginia. The analysis considers three on-farm manure storage options, cost-sharing programs for purchasing manure stor-age facilities, restrictions on nitrogen application rates, and a tax on commercial fertilizer. The CREAMS model was used to estimate nitrate leaching from the crop root zone for various nutri-

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

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ent (and manure) management practices, based on timing and rate of manure and fertilizer applications. The mixed-integer programming economic model considers water quality, policy, and economic constraints in comparing the profitability of alternative cropping and nutrient management systems that reduce groundwater contamination potential. The study provides both the environmental and economic effects of better management of desire water (Austher, abstract). dairy waste. (Author's abstract) W90-06819

EVALUATION OF BEST MANAGEMENT PRACTICES FOR CONTROLLING NONPOINT POLLUTION FROM SILVICULTURAL OPER-

Pennsylvania State Univ., University Park. School of Forest Resources.

J. A. Lynch, and E. S. Corbett.

Mater Resources Bulletin WARBAQ, Vol. 26, No. 1, p 41-52, February 1990. 4 fig. 4 tab, 11 ref. PA Department of Environmental Resources, Bureau of Forestry under Cooperative Agreement ME-

Descriptors: *Clear-cutting, *Forestry, *Nonpoint pollution sources, *Pennsylvania, *Runoff, *Water pollution control, Nitrates, Potassium, Temperature, Turbidity, Water yield.

Fifteen years of streamflow and water quality data were evaluated to determine the effectiveness of Best Management Practices (BMP's) in controlling nonpoint source pollution from an 110-acre commercial clearcut located in the Ridge and Valley Province of central Pennsylvania. The analyses addressed both short-term and long-term changes in the physical and chemical properties and the hydrologic regime of the stream draining this 257-acre watershed. Overall, the BMP's employed on this commercial clearcut were very effective in preventing serious deterioration of stream quality as a result of forest harvesting. Although statistically significant increases in mitrate and potassium concentrations and temperature and turbidity levels were measured the first two years following harvesting, the increases were relatively small and, with the exception of turbidity, within drinking water standards. Nevertheless, such increases may violate EPA's anti-degradation policy. Nitrate and potassium concentrations and turbidity levels remained above pre-harvesting levels for as long as nine years following harvesting. Clearcutting also significantly increased water yield, which in turnitially lowered the concentrations of most solutes because of dilution. Increased water yields returned to pre-harvesting levels within four years as a result of rapid regrowth. The export of some ions increased, however, the increased export appeared to be insufficient to affect site fertility. Implementation of periodic post-harvest inspections of harvesting the width of the buffer. Fifteen years of streamflow and water quality data to be insufficient to affect site fertility, implementation of periodic post-harvest inspections of harvested areas, increasing the width of the buffer zone, and utilizing buffer zones on all perennial and intermittent channels would reduce further impacts of silvicultural activities on water quality. (Author's abstract) W90-06821

CHARGES FOR URBAN RUNOFF: ISSUES IN IMPLEMENTATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of

Geography and Environmental Engineering G. Lindsey.

Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 117-125, February 1990. 4 tab, 16 ref.

Descriptors: *Chesapeake Bay, *Maryland, *Storm runoff, *Urban runoff, *Utilities, *Water pollution control, Economic aspects, Nutrients, Taxes, Wastewater treatment.

Maryland officials have identified stormwater utili-Maryland officials have identified stormwater utili-ties as a potential method of financing programs to control nutrients in urban stormwater runoff that are proposed in Maryland's Chesapeake Bay Nutri-ent Reduction Plan. A number of issues related to the equity, efficiency, and acceptability of user charge schemes are reviewed. Overall, charges are found to be preferable to property taxes from both equity and efficiency perspectives. In addition, evi-dence suggests that elected officials will support

creation of utilities. Obstacles to the implementa-tion of utilities include: adequacy of utility reve-nues and acceptability to the public. (Author's abstract) W90-06828

KINETICS OF CHLORINATED HYDROCAR-BON DEGRADATION BY SUSPENDED CUL-TURES OF METHANE-OXIDIZING BACTE-

Washington Univ., Seattle. Coll. of Forest Re-

S. E. Strand, M. D. Bielland, and H. D. Stensel. Research Journal of the Water Pollution Control Federation JWPFA5, Vol. 62, No. 2, p 124-129, March/April 1990. 10 fig, 3 tab, 19 ref.

Descriptors: *Biodegradation, *Chlorinated hydrocarbons, *Fate of pollutants, *Groundwater pollution, *Microbial degradation, *Water pollution treatment, Trichloroethane, Trichloroethylene.

The kinetics of methane utilization and the biode-gradation of trichloroethylene (TCE) and 1.1.1trichloroethane (TCA) by a mixed, methanotro-phic bacterial culture were studied in a closedsystem reactor. Methane oxidation followed Mi-chaelis-Menten kinetics, TCE and TCA degradation followed first-order kinetics for concentrations less than 3000 microg/L. Oxidative activity of the less than 3000 microg/L. Oxidative activity of the methanotrophic culture ceased at a dissolved TCE concentration of 7770 microg/L. TCA, but not TCE, biodegradation was inhibited by dissolved methane concentrations in excess of 0.25 mg/L. In the absence of methane, the culture continued to degrade TCE and TCA, but degradation ceased after 104 hours. Lower biodegradation rates were observed when treating a mixture of TCE and TCA. (Author's abstract) w90.06832 W90_06835

SUPERFUND RECORD OF DECISION: HAST-INGS GROUND WATER/COLORADO AVE.,

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Avanaoe from the National Technical morthaton Service, Springfield, VA. 22161, as PB89-182471. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R07-88/018, September 1988. 16p, 3 fig, 5 tab.

Descriptors: *Cleanup operations, *Decontamina-tion, *Groundwater pollution, *Hastings, *Nebras-ka, *Site remediation, *Superfund, In situ treat-ment, Monitoring, Soil contamination, Tetrachlor-oethane, Trichloroethene, Volatile organic com-pounds, Water quality control.

The Colorado Avenue subsite of the Hastings Ground Water Contamination site is located in the City of Hastings, Adams County, Nebraska. From 1967 to May 1982 the site was used by Dravo Corporation for manufacturing of heating and air conditioning equipment. Metals were cleaned prior to finishing with a vapor-degreasing process, and the waste solvents were discharged directly into the waste solvents were useful as containing the desired with the sanitary sewer and the storm sewer. The site has since been acquired by Marshalltown Instruments Co., who claims to have no involvement with disposal of the chemical contaminants. Groundwater contamination was discovered when an out-of-service drinking water well was put back in service, resulting in complaints about the water quality. Subsequently, the Nebraska Dept. of Health and the Nebraska Dept. of Environmental reauti and the Neoraska Dept. of Environmental Control began investigating widespread ground-water contamination in the Hastings area. The highest levels of contamination of soil and soil-gas occur along the sanitary and storm sewers at the site, with localized areas which correspond to joints in the sewers. The volume of contaminated coil is estimated to be 42, 700 cm and is the focus soil is estimated to be 42,700 cu yd and is the focus of this record of decision. High levels of the con-taminants are also found in the groundwater beneath the site. The primary contaminants of con-cern affecting soil and groundwater are volatile organic compounds including trichloroethene and tetrachloroethane. The selected remedial action for this site includes: in situ soil vapor extraction; treatment of extracted vapor with an activated

carbon system, if necessary; and implementation of an operation and maintenance program which includes soil, air and groundwater monitoring. W90-06950

SUPERFUND RECORD OF DECISION: AR-KANSAS CITY DUMP, KS.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-182455. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R07-88/014, September 1988. 68p, 7 fig, 8 tab.

Descriptors: *Arkansas City, *Cleanup operations, *Groundwater pollution, *Kansas, *Landfills, *Site remediation, *Superfund, Capping, Hydrocarbons, Monitoring, Oil wastes, Polychlorinated aromatic hydrocarbons, Polycyclic aromatic hydrocarbons, Soil contamination, Sulfuric acid.

The 200-acre Arkansas City Dump site is located in the southwest section of Arkansas City, Cowley County, Kansas, and is bounded on the west and south by a levee that separates it from the Arkansouth by a levee that separates it from the Arkan-sas River. The site was used as an oil refinery between 1916 and the mid-1920s. Residual acid sludge from the distillation process was disposed of in pits or on the ground predominantly in the north waste area. Subsequently, 160 acres were used as a numicipal landfill, referred to as the Arkansas City Landfill. Investigations conducted since 1980 by the Kansas Department of Health and Environ-ment have determined that all media are contami-nated with various organics and inorganics primar-nated with various organics and inorganics primarment have determined that all media are contaminated with various organics and inorganics primarily from refining wastes. The principal contributor of organic contaminants to the groundwater, particularly polynuclear aromatic hydrocarbons (PAHs), appears to be the soil contaminated sediments in the subsurface. However, contaminants are not migrating offsite. The primary contaminants of concern in the acid sludge are organics including PAHs, and sulfuric acid. The selected remedial action for the north waste area operable unit includes: in situ neutralization of the acid sludge followed by the installation of a soil cover; completion of a supplemental feasibility study adressing remedial alternatives for the subsequent operable unit; institutional controls including deed restrictions; and groundwater monitoring. (Lantz-PTT) W90-06951

SUPERFUND RECORD OF DECISION: OAK GROVE LANDFILL, MN.

GROVE LANDFILL, MN.
Environmental Protection Agency, Washington,
DC. Office of Emergency and Remedial Response.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-183883.
Price codes: A04 in paper copy, A01 in microfiche.
Report No. EPA/ROD/R06-88/074, September
1988. 61p, 11 fig, 8 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Landfills, *Minnesota, *Site remediation, *Superfund, Anoka County, Benzenes, Capping, Landfill covers, Monitoring, Organic compounds, Toluene, Volatile organic compounds, Waste disposal, Xylenes.

The Oak Grove Sanitary Landfill covers 45 to 50 acres in Oak Grove Township, Anoka County, Minnesota, approximately 38 miles northwest of St. Paul. The landfill received 200,000 to 300,000 cuy do f waste per year from 1976 until it reached its permitted capacity in late 1983. Most of this waste consists of household trash and garbage. In addition, waste consisting of oil sludge from an oil recycling process, paint and solvent wastes, foundry wastes, metal sludges, organic compounds from pesticide manufacturing, cutting oils and lubricants, cleaning solvents, and inks are reported to have been buried near the center of the landfill but their exact location is unknown. Minnesota Pollution Control Agency (MPCA) and Anoka County records indicate a number of volatilization and operational problems throughout the active history operational problems throughout the active history of the site. MPCA discovered a groundwater con-

tamination problem from monitoring well samples obtained at the site in 1984. The primary contaminants of concern affecting groundwater and surface water are volatile organic compounds (VOCs) including ethyl benzene, toluene and xylenes. The selected remedial action for this site includes: inselected remedial action for this site includes: in-stallation of a security fence; capping with a final cover system consisting of a gas control layer, a barrier layer of low permeable material or a flexi-ble membrane and a drainage layer; topsoil cover one memorane and a dramage layer; topsoil cover and vegetation; deed restrictions; and air and groundwater monitoring. The second remedial action will address the groundwater contamination and possible remediation of the downgradient plume. (Lantz-PTT) W90-06952

SUPERFUND RECORD OF DECISION: LUDLOW SAND AND GRAVEL, NY.

LUDLOW SAND AND GRAVEL, NT.
Environmental Protection Agency, Washington,
DC. Office of Emergency and Remedial Response.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-182521.
Price codes: A04 in paper copy, A01 in microfiche.
Report No. EPA-ROD-R02-88/067, September Report No. EPA-R 1988. 71p, 3 fig, 6 tab.

Descriptors: *Cleanup operations, *Groundwater pollution, *Landfills, *New York, *Site remediation, *Superfund, Landfill covers, Monitoring, Paris, Phenols, Polychlorinated biphenyls, Soil contamination, Volatile organic compounds, Waste

The Ludlow Sand and Gravel site is located approximately six miles south of Utica, in the town of Paris, Oneida County, New York. The site consists of a gravel pit and landfill on a 130-acre tract of land, owned and operated by Mr. James Ludlow. The landfill, which is the focus of this record of decision (ROD), is in a groundwater recharge zone to the principal aquifer along Sauquoit Creek. Various organizations and individuals have disposed of waste at the site since 1966. This waste included domestic wastes, septic tank effluent, industrial wastes such as dves. waste oils and metallurgical waste at the site since 1966. This waste included domestic wastes, septic tank effluent, industrial wastes such as dyes, waste oils and metallurgical cooling oils, and animal parts from a meat processing plant. In late 1982, sampling revealed traces of PCB contamination in the leachate pools on the southern portion of the property. In July 1987, the District Court of Birmingham ordered Mr. Ludlow to cease operations at the site. Mr. Ludlow complied with the court order and closed the landfill by February 15, 1988. The primary contaminants of concern affecting soil, sediments and groundwater are volatile organic compounds (VOCs) including benzene and toluene and organics including polychlorinated biphenyls (PCBs) and phenols. The selected remedial action for this site includes: consolidation and onsite disposal into the landfill of approximately 10,000 cu yd of contaminated soil and sediment adjacent to the landfill, and installation of an impermeable cover over the landfill; implementation of upgradient groundwater controls to lower and prevent the groundwater table from coming in contact with the waste material; access restrictions; and implementation of a long-term water quality monitoring program including both onsite and offsite groundwater, surface water and potable water supply wells. (Lantz-PTT) face water and potable water supply wells. (Lantz-PTT) W90-06953

SUPERFUND RECORD OF DECISION: NA-TIONAL STARCH, NC.

TIONAL STARCH, NC. Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-182497. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R04-88/039, September 1988. 32p, 7 fig, 6 tab.

Descriptors: *Chemical wastes, *Cleanup operations, *Groundwater pollution, *North Carolina, *Site remediation, *Superfund, *Waste disposal, Air stripping, Chemical treatment, Groundwater protection, Heavy metals, Monitoring, Pretreatment of wastewater, Rowan County, Volatile organic compounds.

The National Starch and Chemical Corporation (NSCC) site is located in Rowan County, North Carolina, approximately five miles south of the city Carolina, approximately five miles south of the city of Salisbury. The site consists of 500 acres is occupied by the NCSS-owned Cedar Springs Road Plant which currently manufactures textile finishing and custom specialty chemicals. From 1971 to 1978, NSCC disposed of approximately 350,000 gallons of reaction vessel wash waters classified as D002 waste (corrosive waste with pH < or = 2.0) in trenches constructed in a 5-acre tract of land located behind the plant. The waste consisted predominantly of salt brines, sulfuric acid solutions, sulfonating fats and oils, and solvents. Site monitoring in 1976 and 1977 revealed shallow groundwater contamination adjacent to or within the trench area. Consequently, the North Carolina Department of Natural and Economic Resources requested that NSCC cease onsite waste disposal quested that NSCC cease onsite waste disposal activities. Since 1978, production plant process activities. Since 1978, production plant process waters have been pretreated in a facility adjacent to and south of the production area and discharged to the Salisbury publicly owned treatment works (POTW). The primary contaminants of concern affecting the groundwater, and sediments are volatile organic compounds including benzene, trichloroethene, toluene and xylenes, and metals including arsenic and chromium. The selected remedial action for this site includes: installation of a groundwater interception and extraction system downgradient of the source area(s) with pretreatment prior to discharge to the POTW (such as air stripping, filtration, and/or metal removal); and surface water and sediment monitoring. (Lantz-PTT) PTT) W90-06954

AQUATIC TOXICOLOGY. Virginia Polytechnic Inst. and State Univ., Blacks-burg. Center for Environmental and Hazardous Material Studies. For primary bibliographic entry see Field 5B. W90-06990

INVESTIGATION AND REMEDIATION OF VOCS IN SOIL AND GROUNDWATER. Delta Environmental Consultants, Inc., Fort Collins, CO.

For primary bibliographic entry see Field 5A. W90-06991

EXTRACTION OF TCE-CONTAMINATED GROUND WATER BY SUBSURFACE DRAINS AND A PUMPING WELL. EBASCO Services, Inc., Chicago, IL. D. Meiri, M. Ghiasi, R. J. Patterson, N. Ramanujam, and M. P. Tyson. Ground Water GRWAAP, Vol. 28, No. 1, p 17-24, January/February 1990. 13 fig, 1 tab, 9 ref.

Descriptors: *Cleanup operations, *Decontamina-tion, *Groundwater pollution, *Pump wells, *Sub-surface drains, *Trichloroethylene, *Water pollu-tion control, Aquifer characteristics, Aquifers, Chemical wastes, Geohydrology, Groundwater, Model studies, Ohio, Subsurface drainage.

Groundwater in a shallow glacial till aquifer and a deeper weathered shale aquifer at a site near Rock Creek, Ohio has been contaminated with trichloroethylene (TCE). Evaluation of remedial alternatives indicated that a system of subsurface drains would be most effective for decontaminating the would be most effective for decontaminating the shallow groundwater. The performance of the pro-posed subsurface drainage system for the shallow aquifer was simulated using finite-element flow and transport models. Model results indicate that the drains should reduce TCE concentration in the trains should reduce Tee Concentration in the shallow aquifer to about 8 ppb in approximately 24 years. A single extraction well was the selected alternative to remediate trichloroethylene concen-trations in the deeper weathered shale aquifer. The trations in the deeper weathered shale aquifer. The performance of the proposed well was analyzed by an analytical model. Results of the analysis indicated that the extraction well should reduce contamination in less time than required for the shallow glacial till aquifer. A single extraction well installed in the lower weathered shale aquifer should produce a steady-state capture zone with a downgradient extent of approximately 225 ft from the

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well. If it is assumed that the contaminant plume in the weathered shale has the same areal extent as the plume in the glacial till, one well should pro-vide containment. Since the porosity of the shale lower than the shallow till but the extraction rate is lower than the shallow till but the extraction rate is about the same as from the trenches, the proposed extraction system should capture contaminated groundwater in the shale and reduce concentrations to low levels in less time than is required for the shallow aquifer. (Author's abstract) W90-07011

WATER QUALITY MODEL FOR THE TIGRIS RIVER DOWNSTREAM OF SADAM DAM, TRAO.

Univ. (Iraq). Saddam Dam Research For primary bibliographic entry see Field 7C. W90-07025

TOXICITY AND ACCUMULATION OF CHRO-MIUM IN CERATOPHYLLUM DEMERSUM L. National Botanical Research Inst., Lucknow (India). Aquatic Botany Lab. For primary bibliographic entry see Field 5D. W90-07037

REMOVAL OF SOME HEAVY METALS BY MORDENITE.

Delaware Univ., Newark. Dept. of Civil Engineer-For primary bibliographic entry see Field 2K. W90-07052

EFFECTS OF SLUDGE RECYCLE RATIO ON NITRIFICATION-DENITRIFICATION PER-FORMANCE IN BIOLOGICAL TREATMENT

British Columbia Univ., Vancouver, Dept. of Civil eering. Engineering.

P. Elefsiniotis, R. Manoharan, and D. S. Mavinic.
Environmental Technology Letters ETLEDB,
Vol. 10, No. 12, p 1041-1050, December 1989. 7
fig. 2 tab, 15 ref.

Descriptors: *Biological wastewater treatment, *Denitrification, *Landfills, *Leachates, *Nitrification, *Sludge, *Wastewater treatment, *Water pollution control, *Water pollution treatment, Aerobic conditions, Ammonia, Anoxic conditions, Britsh Columbia, Canada, Nitrates, Nitrites, Sludge recycle, Suspended solids, Water quality control.

Ammonia removal from leachate through a biological nitrification-denitrification process and the effect of sludge recycle ratio on effluent levels of nitrates and nitrites were studied. Leachate from an older landfill in British Columbia, Canada was an older landill in British Columbia, canada was used in a system with anoxic and aerobic reactors. Settled sludge was recycled to improve system performance. Effluent ammonia was consistently low and was not significantly affected by sludge low and was not significantly affected by studge recycle ratios. The system performance was opti-mum at ratios of 5:1 and 6:1. Higher ratios caused the system to destabilize. A 6:1 ratio also produced minimum effluent nitrates, nitrites, and suspended solids. (Miller-PTT) W90-07057

DAPHNIA AND TOXIC BLOOMS OF MICRO-CYSTIS AERUGINOSA IN BAUTZEN RESER-VOIR (GDR).

Technische Univ., Dresden (German D.R.). Sektion Wasserwesen. For primary bibliographic entry see Field 2H. W90-07096

COMPREHENSIVE EVALUATION OF THE RESULTS OF THE DAPHNIA TEST CARRIED OUT AT THE TISZA-SECTION AND MAJOR DISTRICT WATERS IN SZOLNOK COUNTY

Szolnok County Service of Public Health and Epidemiology (Hungary). Water Microbiological Lab. Tiscia TSCAB8, Vol. 24, p 35-41, 1989. 2 fig, 2 tab,

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G-Water Quality Control

Descriptors: *Bioassay, *Daphnia, *Hungary, *Tisza River, *Toxicity, *Water pollution, *Water pollution prevention, Temperature effects.

Since 1974 the Water Microbiological Laboratory of the Service of Public Health and Epidemiology of Szolnok County, Hungary has performed regular chemical, bacteriological, biological and toxicological studies of the Tisza River. Between 1977 and 1987 acute toxicological studies were carried out with Daphnia magna at eight points on the section of the Tisza in Szolnok county and at the major district waters of the region. During the period studied 19.4% of the Tisza water samples and 4.8% of the samples originating from the district waters were toxic to Daphnia. The Tisza River water was toxic for Daphnia primarily in autumn, winter, and early spring, indicating the role of temperature on the effects of the microcontaminants. From 1975 on, the toxicity of the Tisza water samples taken frequently above the area of the Surface Water Works in Szolnok showed a strong decreased, falling from 74% to 1%. The observed phenomenon can be explained most probably by the beneficial effect of the Vision observed phenomenon can be explained most prob-ably by the beneficial effect of the Kiskore storage lake, since the drastic decrease of the high rate of toxicity observed previously coincided with the filling up of the lake between 1979-1983. (Author's abstract) W90-07120

FARM INCOME AND GROUND WATER QUALITY IMPLICATIONS FROM REDUCING SURFACE WATER SEDIMENT DELIVERIES. Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 4D.
W90-07211

IMPROVED GROWTH IN STUNTED BROWN TROUT (SALMO TRUTTA L.) AFTER RELIM-ING OF LAKE HOVVATN, SOUTHERN

Bergen Univ. (Norway). Zoological Museum. B. T. Barlaup, A. Atland, G. G. Raddum, and E.

Water, Air and Soil Pollution WAPLAC, Vol. 47, No. 1-2, p 139-151, September 1989. 5 fig, 5 tab, 34

Descriptors: "Acid lakes, "Acid rain, "Fish growth, "Growth, "Lake restoration, "Liming, "Norway, "Trout, "Water quality control, Acidic water, Lake Hovvatn, Lake Pollen.

The chronically acidic Lake Hovvatn and the ad-The chronically acidic Lake Hovvatn and the adjoining pond Pollen in southermost Norway were limed in March 1981. The two locations were stocked with brown trout (Salmo trutta) at low and high densities in Hovvatn and Pollen, respectively. After 6 yr of reacidification, the locations were relimed in July 1987. Growth depression during the reacidification process in spite of low fish densities and superabundance of food was observed in Lake Store Hovvatn. Three months after reliming, a substantial growth response was found served in Lake Store Hovvatn. Three months after reliming, a substantial growth response was found in trout from Lake Store Hovvatn. Mean annual length increment was 68% higher than that of the preceding year. In Pollen, reliming had no apparent effect on growth. In both populations reliming caused increased swimming activity measured as an increase in CPUE (Catch per Unit Effort) values. These results show that the growth response to liming depends on population density and food availability. The results also indicate that the food conversion rate of the trout is negatively affected in acid waters. (Author's abstract) affected in acid waters. (Author's abstract) W90-07223

EXCAVATION OF AN INSTRUMENTED EARTHEN LINER: INSPECTION OF DYED FLOW PATHS AND MORPHOLOGY.

Illinois State Geological Survey Div., Champaign.
K. A. Albrecht, B. L. Herzog, L. R. Follmer, I. G.
Krapac, and R. A. Griffin.
Hazardous Waste and Hazardous Materials
HWHME2, Vol. 6, No. 3, p 269-279, Summer
1989, 6 fig., 1 tab, 8 ref. EPA Cooperative Agreement EPA-CR-821650-01.

Descriptors: *Hydraulic conductivity, *Landfills, *Liners, *Water pollution prevention, Civil engineering, Dyes, Lifts, Measuring instruments, Performance evaluation, Tracer studies.

The effective life of a compacted earthen liner used in a land disposal facility depends on its ability to limit movement of contaminants into the ability to limit movement of contaminants into the underlying goundwater flow system. A small, 3 x 9 x 0.9 m, experimental earthen liner was constructed using full-size compaction equipment. The liner was build using six 15-cm-thick lifts. Water containing fluorescein and rhodamine WT dyes was allowed to infiltrate under ponded conditions for the days. The partners observed during expansion allowed to innurate under ponded conditions for 46 days. Dye patterns observed during excavation of the liner indicated that lateral flow occurred between lifts. Although the US EPA hydraulic conductivity criterion for liners (< 0.000001 cm/ sec) was met, the dye experiment showed a need sec) was met, the dye experiment showed a need for better bonding between lifts to prevent preferential flow at lift interfaces. Morphological study of two profiles in the liner revealed variation in the degree of compaction within lifts. Vertical and horizontal installation techniques for moisture and solute monitoring devices (tensiometers, gypsum blocks, and soil-water suction lysimeters) were compared. Instruments functioned in either orientation. However, the horizontal instruments, which were installed during liner construction were necessive. tation. However, the horizontal instruments, which were installed during liner construction, were necessarily installed at lift interfaces, which may be preferential flow paths. In addition, horizontal instruments may be destroyed if the lift thickness is decreased and/or longer compactor feet are used. No evidence of channeling was observed along vertically-installed instruments, which were deemed more satisfactory than horizontally-installed instruments. (Author's abstract)

ACUTE TOXICITY OF INDUSTRIAL AND MU-NICIPAL EFFLUENTS IN THE STATE OF MARYLAND, USA: RESULTS FROM ONE YEAR OF TOXICITY TESTING.

Johns Hopkins Univ., Laurel, MD. Applied Physics Lab. For primary bibliographic entry see Field 5A. W90-07311

COMPLYING WITH THE NEW DRINKING WATER QUALITY REGULATIONS.

American Water Works Association, Denver, CO. W. Pontius

Journal of the American Water Works Association JAWWA5, Vol. 82, No. 2, p 32-52, February 1990. 1 fig, 23 tab, 45 ref.

Descriptors: *Drinking water, *Regulations, *Safe Drinking Water Act, *Water quality standards, Coliforms, Copper, Environmental Protection Agency, Fluorides, Heavy metals, Lead, Organic compounds, Radioisotopes, Tap water, Utilities, Water treatment. Water treatment.

The 1986 amendments to the Safe Drinking Water The 1986 amendments to the Safe Drinking Water Act mandate the establishment of new drinking water quality and treatment regulations. In fulfilling this mandate, the Environmental Protection Agency (EPA) is in the process of developing, proposing, and promulgating drinking water quality regulations that will change significantly water treatment practice and water utility operations. New regulations for volatile organic chemicals, fluoride, surface water treatment, and total coliform bacteria have been promulgated. Regulations for synthetic organic and inorganic chemicals and lead and copper have been proposed. Regulations lead and copper have been proposed. Regulations for radionuclides, additional synthetic organic and inorganic chemicals, and disinfectants and disinfection by-products are under development. The 1986 amendments require the EPA to change and accelerate the regulation development process it had been following since 1974. For each of the regulatbeen following since 19/4. For each of the regular-ded substances or groups of substances, there are specific compliance issues that must be addressed. For example, for lead and copper, compliance issues include the location at which monitoring should be required (tap or plant), the level at which the maximum contaminant level should be set, and whether the rule should include mandatory lead-service-line replacement. The new drinking water quality regulations and those to appear later

will have significant effects on utility operations. will nave significant effects on utility operations. A variety of resources are being developed to help utilities in complying with the new regulations. The new regulations will place a particularly heavy burden on state drinking water programs, which have the major responsibility for implementation and enforcement. Drinking water suppliers will need to carefully evaluate, optimize, and performent their current water transmit presents. haps change their current water treatment practices. (Rochester-PTT) W90-07326

MCL NONCOMPLIANCE: IS THE LABORA-TORY AT FAULT. Hunton and Williams, Richmond, VA. For primary bibliographic entry see Field 5F. W90-07327

STANDARDS OF MINERAL CONTENT IN DRINKING WATER. California Univ., Berkeley. School of Public

For primary bibliographic entry see Field 5F. W90-07328

COMPARISON OF EROSION AND WATER POLLUTION CONTROL STRATEGIES FOR AN AGRICULTURAL WATERSHED.

Missouri Univ.-Columbia. Dept. of Agricultural T. Prato, and H. Shi.

Water Resources Research WRERAQ, Vol. 26, No. 2, p 199-205, February 1990. 6 tab, 27 ref.

Descriptors: *Agricultural watersheds, *Erosion control, *Idaho, *Nonpoint pollution sources, *Water pollution control, Agriculture, Comparison studies, Economic aspects, Vegetation.

The effectiveness and efficiency of two erosion control strategies and one water pollution control (riparian) strategy are compared for Idaho's Tom Beall watershed. Erosion control strategies maximum control strategies maximum control strategies maximum control strategies maximum control strategies. mize annualized net returns per hectare on each field and restrict field erosion rates to no more than 11.2 to 16.8 tons per hectare. The riparian strategy uses good vegetative cover on all fields adjacent to the creek and in noncropland areas and a resource the creek and in noncropland areas and a resource management system that maximizes annualized net returns per hectare on remaining fields. The Agricultural Nonpoint Source Pollution model was used to simulate the levels and concentrations of sediment, nitrogen, phosphorus, and chemical oxygen demand at the outlet of the watershed. Errosion control strategies generate less total erosion and water pollution but are less efficient than the riparian strategy. The riparian strategy is less equitable for farmers than the erosion control strategies. Both erosion control and riparian strategies reduce net farm income below the baseline level. (Author's abstract)

BANNING TRICHLOROETHYLENE: SPONSIBLE REACTION OR OVERKILL. Oregon State Univ., Corvallis. Dept. of Civil Engi-

neering.
F. D. Schaumburg.
Environmental Science and Technology
ESTHAG, Vol. 24, No. 1, p 17-22, January 1990. 7

Descriptors: *Chlorinated hydrocarbons, *Fate of pollutants, *Groundwater pollution, *Hazardous waste disposal, *Hazardous wastes, *Organic solvents, Carcinogens, Water pollution effects

Background information is provided for the use, disposal, fate, and impact of trichloroethylene (TCE) from the 1940s to the present. TCE is a synthetic, chlorinated organic chemical that fulfills all requirements for the ideal degreasing solvent. Although no direct evidence existed in the past, or even now, that the ingestion of small amounts of TCE elicits a carcinogenic response in humans, the scientific community and environmental regulatory agencies concluded in 1976 that TCE was a suspected carcinogen and should be banned. Over the

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years, TCE has been discharged to the nation's surface waters and groundwaters by industry, commerce, and individual consumers. TCE was discovered in the fall of 1979 in a groundwater aquifer in the vicinity of Sacramento, California. Prior to the 1980s, the paucity of technical literature suggests that there was little concern about chlorinated solvents in university research programs, regulatory agencies, industry, or the general public. Recently however, considerably more interest in these chemicals has been generated, as many have now been identified as hazardous substances. Prior to the mid-1970s, there were no analytical methods available to environmental analysts to measure, or even detect, specific chlorinated solvents such as TCE in water. In 1974, Bellar and Lichtenberg described a gas chromatographic method that could separate and detect chlorinated solvents in water in the parts-per-billion range. TCE was disposed of directly onto the land at military installations through the 1970s. Court litigations and environmental cleanup efforts involving TCE are now costing billions of dollars. (Geiger-PTT)

AZOLLA PINNATA R.BR. AND LEMNA MINOR L. FOR REMOVAL OF LEAD AND ZINC FROM POLLUTED WATER. Indian Inst. of Tech., New Delhi. Centre for Rural

Indian Inst. of Tech., New Delhi. Centre for Rural Development and Appropriate Technology. S. K. Jain, P. Vasudevan, and N. K. Jha. Water Research WATRAG, Vol. 24, No. 2, p 177-183, February 1990. 4 fig, 8 tab, 30 ref.

Descriptors: *Aquatic plants, *Duckweed, *Lead, *Wastewater treatment, *Water pollution control, Heavy metals, Metal uptake, Water velvet, Zinc.

The uptake of lead and zinc by Azolla pinnata (water velvet) and Lemna minor (duckweed) was investigated in solutions, enriched with 1.0, 2.0, 4.0 and 8.0 mg/L of these two metal ions, which were renewed on alternate days over a 14 day test period. The uptake rate of both metal ions was highest when the initial concentration in the test solution was 1.0 mg/L. The concentration of lead or zinc remaining in the residual solutions after treatment with duckweed or water velvet at 1.0 and 1.0 mg/L levels, increased with the passage of time. At 4.0 and 8.0 mg/L levels, the concentration of lead or zinc remaining in the residual solutions either continuously increased with the passage of time or, first sharply increased (8-10 days) and then remained almost constant. The presence of one metal ion in solution decreased the uptake rate of the other; e.g. when water velvet was kept in a solution containing lead alone at 8.0 mg/L level, the value of the concentration factor was 54.5. However, in the presence of equal concentrations of zinc (mixed metal group), the value of the concentration factor for lead decreased to 35.44, indicating the influence caused by the presence of the zinc ion. The effect of these metal ions on biomass growth rate was also studied. (Author's abstract)

BIOREMEDIATION OF CHLOROPHENOL CONTAINING SIMULATED GROUND WATER BY IMMOBILIZED BACTERIA.

Alko Ltd., Helsinki (Finland). R. J. Valo, M. M. Haggblom, and M. S. Salkinoja-

Water Research WATRAG, Vol. 24, No. 2, p 253-258, February 1990. 5 fig, 1 tab, 25 ref.

Descriptors: *Biodegradation, *Chlorinated aromatic compounds, *Groundwater pollution, *Wastewater treatment, *Water pollution treatment, *Water treatment, Carbon dioxide, Inorganic chloride, Polymers, Temperature.

Chlorophenol-mineralizing rhodococci were immobilized on a polyurethane carrier. A column with polyurethane immobilized biomass was fed with technical chlorophenol (3-130 mg/L) contaminated water. The chlorophenol concentration of the column effluent was 1/1000-1/10,000 of the influent concentration. Inorganic chloride in effluent water and carbon dioxide in exhaust gas were

found as products. The polymer immobilized biomass adsorbed chlorophenols effectively both at room temperature and at the local groundwater temperature (+4 degrees C). The temperature was intermittently increased to 25 degrees C to allow the immobilized bacteria to biodegrade the adsorbed chlorophenols. Life-time of the immobilized rhodococci was several months. The degradation of chlorophenols by the immobilized cells proceeded in the absence of an additional carbon source. The method described can be applied to remove chlorophenols from groundwater. (Author's abstract)
W90-07429

GAS EXCHANGE THROUGH THE SOIL-AT-MOSPHERE INTERPHASE AND THROUGH DEAD CULMS OF PHRAGMITES AUSTRALIS IN A CONSTRUCTED REED BED RECEIVING DOMESTIC SEWAGE.

Aarhus Univ. (Denmark). Botanical Inst. For primary bibliographic entry see Field 5D. W90-07430

ENVIRONMENTAL EVALUATION AND RESTORATION PLAN OF THE HOE CREEK UNDERGROUND COAL GASIFICATION SITE, WYOMING.

WYOMING.
University of Wyoming Research Corp., Laramie.
Western Research Inst.

Western Research Inst.

W. L. Barteaux, G. L. Berdan, and J. Lawrence.
Available from the National Technical Information
Service, Springfield, VA. 22161, as DE89-000917.
Price codes: A04 in paper copy, A01 in microfiche.
Report No. DOE/MC/11076-2641, September
1986. 98p, 46 fig, 13 tab, 41 ref, append. DOE
Contract DE-FC21-86MC11076.

Descriptors: *Cleanup operations, *Coal gasification, *Hoe Creek, *Site remediation, *Wyoming, Activated carbon, Adsorption, Environmental impact statement, Phenols, Water pollution treatment.

Three underground coal gasification (UCG) experiments were conducted by at the Hoe Creek Site, Wyoming; the Hoe Creek II experiment was conducted in 1976, the Hoe Creek II experiment in 1977, and the Hoe Creek III experiment in 1977. These experiments have had an impact on the land and groundwater quality at the site, and the Department of Energy (DOE) has requested that a site restoration plan be developed and implemented. The purpose of the plan is to restore the site to conditions being negotiated with the Wyoming Department of Environmental Quality (WDEQ). Surface restoration activities were scheduled in four phases: Phase 1—this phase of surface restoration began in late October and ran through November 1979. Restoration included the replacement and contouring of topsoil. The soil was disked to a depth of 6 to 8 inches; the areas were then seeded using a rangeland drill equipped with depth bands set to 1/2 to 3/4 inches. Pour grass species were planted, and revegetation of the site has been successful. Phase 2—this phase of restoration took place during the spring and summer of 1980. Three and 2/5 acres of disturbed land were reclaimed as described above. Phase 3—took place during the spring of 1981. All equipment and structures were removed from the site, and the equipment storage and office areas were reclaimed. The sediment pond area, along with all berms and trenches, was also restored. Phase 4—all groundwater monitoring wells will be cut, sealed, and capped. Any surface disturbances associated with well removal will be reclaimed. Phenols are the only compounds in recent Hoe Creek groundwater samples which exceed the target levels proposed by the DOE. Phenol levels at the site were as high as 1400 parts per billion in May 1986. Several groundwater are soluble and of intermediate strength, carbon adsorption was selected as the most efficient and effective means of removing phenols from the groundwater. (Lantz-PTT) W90-07464

AMBIENT WATER QUALITY CRITERIA FOR 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN.

Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards. Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-169825. Price codes: A10 in paper copy, A01 in microfiche. Report EPA/440/5-84/007, Feb 1984. 288p, 32 tab, 112 ref.

Descriptors: *Clean Water Act, *Dioxins, *Standards, *Water quality standards, Organic compounds, Water quality.

Pursuant to section 304(a)(1) of the Clean Water Act, this document was developed to publish criteria for water quality accurately reflecting the latest scientific knowledge. A summary of the criteria for 2,3,7,8-trachlorodibenzo-p-dioxin (TCDD) is as follows. Not enough data are available concerning the effects of 2,3,7,8-TCDD on aquatic life and its uses to allow derivation of national criteria. For the maximum protection of human health from the potential carcinogenic effects due to exposure to 2,3,7,8-TCDD through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Recommended criteria are 130, 13, and 1,3 fg/L respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 140, 14, and 1,4 fg/L respectively. Other concentrations representing different risk levels may be calculated. The risk estimate range is presented for information purposes and does not represent an Agency judgement on an "acceptable" risk level. (Author's abstract)

SUPERFUND RECORD OF DECISION; HENDERSON ROAD, PA.

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-183891. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/R03-88/049, June 1988. 125p, 17 exhibits.

Descriptors: *Cleanup operations, *Path of pollutants, *Pennsylvania, *Site remediation, *Superfund, Air stripping, Excavation, Groundwater pollution, Monitoring, Organic compounds, Upper Merion, Volatile organic compounds, Water pollution sources.

The Henderson Road site is an active waste facility situated on 7.6 acres of land in Upper Merion Township, Pennsylvania. The land in the vicinity of the site is zoned for light industrial, heavy industrial and residential use. The O'Hara Sanitation Company (OSL) presently occupies the site with several automobile repair shops and a drilling contractor. The OSL presently conducts onsite waste storage and waste recycling operations. An anonymous phone call to the Pennsylvania Department of Environmental Resources (PADER) in 1977 stated that ABM Disposal Service Company transported and then injected industrial waste into a well located inside the OSL maintenance garage. Results of PADER and EPA sampling conducted between 1977 and 1981, and groundwater monitoring conducted in 1986 revaled the presence of organic and volatile organic compound (VOC) contamination both on and offsite. Of the 35 chemicals of concern identified at the site, fifteen were found in the Upper Merion Reservoir (UMR) in 1986. The site is located in an area of regional groundwater contamination. Studies also indicate that the central plume of contamination from the site has not yet reached the UMR, based on an estimated travel time for groundwater recovery wells and treatment using air stripping with probable discharge to an adjacent stream, and possible discharge to a andjacent stream, and possible discharge to a andjacent stream, and possible discharge to a andjacent stream, and possible discharge to a portion of the treated groundwater onto an area near the injection well as part of the unsaturated zone treatment (soil flushing); closure of the injection well; excavation of contaminated

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oil pit sediment and removal of significant waste; deed restrictions affecting groundwater usage; groundwater monitoring; and periodic reevaluation of cleanup goals. (Lantz-PTT) W90-07471.

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) FOR POLLUTION CONTROL AND WASTE TREATMENT (APR 75 - JAN 90).

National Technical Information Service, Springfield, VA.

For primary bibliographic entry see Field 5D. W90-07472

SUPERFUND RECORD OF DECISION: GURLEY PIT, AR.

GURLEY PI1, AR.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-182448. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R06-88/046, September 1988. 16p, 3 fig, 4 append.

Descriptors: *Arkansas, *Cleanup operations, *Site remediation, *Superfund, Acids, Edmondson, Groundwater pollution, Inorganic compounds, Oil wastes, Polychlorinated biphenyls, Waste disposal, Water pollution sources.

The Gurley Pit site consists of a 3.25-acre pit located approximately one mile north of Edmondson, Crittendon County, Arkansas. The site lies within the 100-year flood plain of Fifteen Mile Bayou, which discharges to the Mississippi River. The primary land use is agricultural. Gurley Refining Company (GRC) leased the site from R. A. Caldwell between 1970 and 1980. During this time the pit was divided by levees into three cells and used between 1970 and 1975 as a state permitted disposal site for secondary oil refining wastes including acids, oil sludges, polychlorinated biphensyls (PCBs), inorganics and spent diatomaceous wastes. In May 1978, EPA and the Arkansas Department of Pollution Control and Ecology (ADPCE) received complaints of chronic overflows from storm runoff. These overflows had an adverse affect on fish and waterfowl in the Fifteen Mile Bayou. EPA completed an Enforcement Decision Document (EDD) in October 1986, which addressed the source control operable unit consisting of the waste in the pits and the surface contamination. The selected source control remedy included treatment and discharge of onsite surface water, offsite incineration of PCB-contaminated oil, groundwater monitoring, and stabilization and consite disposal of contaminated lauge, sediment, and soil. This record of decision addresses the groundwater operable unit. Investigations have determined that contaminants from the pit have not migrated through the subsurface into the groundwater. Elevated levels of inorganics (specifically arsenic and manganese) were detected but were consistent with background levels. No site-related contaminants were identified in the groundwater. The selected remedial action for this site is no further action beyond that already specified in the source control operable unit EDD. (Lantz-PTT) W90-07474

SUPERFUND RECORD OF DECISION: NORTHSIDE SANITARY LANDFILL/ENVI-RONMENTAL CONSERVATION AND CHEMI-CAL, IN.

Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-184071. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-87/049, September 1987. 100p, 3 fig.

Descriptors: *Cleanup operations, *Indiana, *Site remediation, *Superfund, Benzenes, Boone County, Capping, Dewatering, Excavation, Groundwater pollution, Inorganic compounds, Landfills, Organic compounds, Peticides, Volatile organic compounds, Water pollution sources.

The Enviro-Chem Corporation (also referred to as Environmental Conservation and Chemical Corporation, or ECC) and Northside Sanitary Landfill (NSL) are both on the Superfund National Priorities List, and are adjacent to each other. These sites are located in a rural area of Boone County, sites are located in a rural area of boone County, about five miles north of Zionsville and ten miles northwest of Indianapolis. ECC began operations in 1977 and was engaged in the recovery/reclamation/brokering of primary solvents, oils, and other wastes received from industrial clients. Waste products were received in drums and bulk tankers nd prepared for subsequent reclamation or dispos-l. Sometime between 1955 and 1962, NSL began landfill operations. From 1972 to 1973, numerous operational deficiencies, including failure to cover refuse, surface burning, underground fires, leachate and vermin problems resulted in three Indiana State Board of Health (ISBH) orders to cease State Board of Health (ISBH) orders to cease operations. Operations were permitted at the site by February 1975. By November 1982, NSL had accepted at least 16 million gallons of hazardous substances. Groundwater, surface water, soil and sediments are contaminated with inorganics, organics, pesticides, acids, base-neutral compounds, oils and volatile organic compounds (VOCs), in-cluding benzene. The recommended alternative for o sites combined includes: implementing deed and access restrictions to prevent future si development; excavation and dewatering of 4,200 cu yd of leachate soils and sediments with onsite disposal under a Resource and Conservation Recovery Act (RCRA) multi-layer cap; soil capping on non-RCRA capped areas; site grading; demolition of former ECC process building followed by capping; rerouting of surface waters; leachate collection and treatment at NSL; and groundwater collection and onsite treatment for both sites. The estimated present worth cost for this remedial action is \$33,900,000. (Lantz-PTT)
W90-07475

MOBILITY OF COLLOIDAL PARTICLES IN THE SUBSURFACE: CHEMISTRY AND HYDROLOGY OF COLLOID-AQUIFER INTERACTIONS.

Oak Ridge National Lab., TN. Environmental Sciences Div. For primary bibliographic entry see Field 5B. W90-07482

EVALUATION OF MID-TO-LONG TERM BASIC RESEARCH FOR ENVIRONMENTAL RESTORATION: PRELIMINARY ANALYSIS TO CHARACTERIZE DOE WASTE PROB-LEMS IN A 5-TO 20-YEAR TIMEFRAME AND TO IDENTIFY RESEARCH NEEDS.

Department of Energy, Washington, DC. Office of Energy Research. Report no. DOE/ER-0419, September 1989. 149p, 5 fig, 9 tab, 41 ref, 8 append.

Descriptors: *Cleanup operations, *Research priorities, *Site remediation, *Waste disposal, *Waste management, *Water pollution treatment, Environmental restoration, Technology, Waste load, Waste-assimilative capacity.

Department of Energy (DOE) problems in the long term are being analyzed scientifically and research needs are being identified. When completed, the Office of Energy Research's basic research plan will describe potential scientific research needs for universities, national laboratories, and others as a basis for research proposals to DOE. Extensive interaction with the scientific community is planned to further refine and prioritize research needs. The objectives of this document are to define and categorize DOE's environmental restoration problems, as a basis for identifying the research needs, which will be more fully defined and prioritized from workshops held over the next year or more. The objectives of DOE's environmental restoration and waste management program are to: reduce environmental and health and safety risks that result from past waste disposal and management practices; develop new methods and technologies that will more effectively and economically solve waste management and environmental restoration problems; limit further environmental contamination by developing new ways to stabilize

wastes for future remediation, or by altering or destroying those wastes that can be treated; and reduce the quantities of wastes generated through process changes and facility modernization. (Lantz-PTT) w90-07486

SUPERFUND RECORD OF DECISION: MARATHON BATTERY, NY.

THON BATTERY, NY.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-188783.
Price codes: AT in paper copy, AOI in microfiche.
EPA Report No. EPA/ROD/R02-88/064, September 1988. 231p, 5 fig, 7 tab, 3 append.

Descriptors: *Cleanup operations, *Hudson River, *New York, *Site remediation, *Superfund, Cadmium, Dredging, Industrial wastewater, Nickel, Spoil disposal, Waste disposal.

Spoil disposal, Waste disposal.

The Marathon Battery Company (MBC) site, a former battery manufacturing plant, is located in the Village of Cold Spring in Putnam County, New York, approximately 40 miles north of New York City. The site operated from 1952 to 1979 producing military and commercial batteries. During this time the site changed ownership several times, finally operating as the MBC from 1969 to 1979. Before 1965, the plant's wastewater treatment system discharged into the Hudson River at the Cold Spring pier via the Cold Spring sewer system, except during periods of overload or system shutdown during which time the process effluent was discharged directly into East Foundry Cove Marsh (EFCM) to the southeast. Between November 1972 and July 1973, a limited cleanup was conducted by MBC and other responsible parties, to remove sediment from parts of Foundry Cove and surrounding areas contaminated with cadmium and nickel in excess of 900 mg/kg. Approximately 5,000 cu yd of Cd-contaminated sediments were dredged and subsequently placed in a clay-lined underground vault on the plant property. However, studies conducted in Foundry Cove between 1976 to 1980 continued to detect Cd and Ni concentrations in excess of 900 mg/kg. To expedite remediation, the site has been divided into three separate geographic areas as follows: Area I, EFCM and Constitution Marsh southeast of the plant; Area II, the 11-acre former battery manufacturing facility (presently used as a book respository), a production well, a 500,000 gallon water tower, building debris, a dredge spoils vault, a parking lot, and nearby residential yards; and Area II, EFCM and replacing the sediments with clay and clean fill. This ROD addresses Area II including localized soil contamination primarily in the area around the building, under debris, and around the parking lot; dust inside the building; and the sludge spoils vault. A subsequent ROD will address Area III. The primary contaminants of concern affecting the groundwater, soil, debris, and inside

TRENDS IN OIL DISCHARGED WITH AQUE-OUS EFFLUENTS FROM OIL REFINERIES IN WESTERN EUROPE, 1987 SURVEY. CONCAWE, The Hague (Netherlands). For primary bibliographic entry see Field 5B. W90.07491

KANSAS CLEAN LAKES PROGRAM, LAKE OLATHE, CITY OF OLATHE, KANSAS. Kansas Dept. of Health and Environment, Topeka. For primary bibliographic entry see Field 4C. W90.07492

CAPITAL LAKE FINAL REPORT.

South Dakota Dept. of Water and Natural Resources, Pierre. For primary bibliographic entry see Field 4D. W90-07493

LIBERTY LAKE RESTORATION PROJECT. COMPLETION REPORT.

Kennedy (Michael) Consulting Engineers, Spo-kane, WA.

Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-209050. Price codes: Al 3 in paper copy, A01 in microfiche. Final Report prepared for Liberty Lake Sewer District, Liberty Lake, WA, March 1985. 244p, 92 fig. 31 tab, 63 ref, 2 append.

Descriptors: *Eutrophic lakes, *Lake restoration, *Liberty Lake, *Washington, *Water quality control, Algae, Algal blooms, Alum, Dredging, Eutrophication, Marshes, Monitoring, Nutrients, Phosphorus, Phytoplankton.

In the mid-1960's Liberty Lake, located in east central Spokane County, Washington, exhibited symptoms of eutrophication-decrease in water clarity, massive blue-green algal blooms and excessive aquatic plant growth. By 1968 large masses of decaying algae and plant fragments were being deposited on the lake's beaches. That year members of the Liberty Lake Property Owner's Association, took a first step in restoring water quality. For Liberty Lake, a wide range of studies were performed over many years before possible restoration procedures were recommended. These studies pointed to high levels of phoshorus (a prime ration procedures were recommended. I ness stud-ies pointed to high levels of phosphorus (a prime algal and plant nutrient) in certain inflows to the lake and within the lake sediments, as the cause of the observed eutrophic conditions. The first struc-tural effort was the sewering of the developed areas of the lake basin. While this would eventually eliminate the largest source of phosphorus, investi-gators noted that due to other inputs and substan-tially amounts of phosphorus held in the sediments and aquatic plants, further measures were needed. These included diversion of flood flows around the marsh at the south end of the lake, an alum treat-ment of the entire lake, dredging of 50 acres of the most enriched sediments, a water quality monitor-ing effort during and after the in-lake work, and a ing effort during and after the in-lake work, and a study of stormwater runoff. These measures are collectively called the Liberty Lake Restoration Project. The water clarity in Liberty Lake during the summer and fall of 1984 was better than it had been for almost ten years. By this visual measure the lake residents and users consider the restoration a success. After 4 years of water quality monitoring, nutrient levels in the lake and inflowing waters have been reduced and the trophic state has declined toward a more mesotrophic condihas declined toward a more mesotrophic condi-tion. Comparison of pre-restoration and post-resto-ration nutrient budgets indicates that a reduction in phosphorus loading of 34% was achieved. This percentage is just under the 40% predicted during percentage is just under the 40% predicted during the planning stage of the project. It appears that the sewering was primarily responsible for this reduction. Even though the desired change in the phytoplankton community (from primarily bluegreen to primarily green algae) was not seen, indications are that long-term productivity and incidence of blue-green blooms has been significantly reduced. (Lantz-PTT) W90-07494

SURVEY AND CLASSIFICATION OF DELA-WARE'S PUBLIC LAKES.

Delaware State Dept. of Natural Resources and Environmental Control, Dover. For primary bibliographic entry see Field 2H.

DELAWARE PARK LAKE REVITALIZATION PROJECT.

New York State Dept. of Environmental Conser-

vation, Albany.

Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-209035.

Price codes: A03 in paper copy, A01 in microfiche.

Summary Report, October 1985. 35p, 33 photo-

Descriptors: *Cleanup operations, *Delaware Park Lake, *Lake restoration, *New York, Black Rock Canal, Detritus, Erosion, Flood routing, Manage-ment planning, Public health, Recreation, Scaja-quada Creek, Wastewater disposal.

Delaware Park Lake in Buffalo, New York was originally conceived > 100 years ago to enhance the esthetic appeal of a 500 acre tract of land set aside for a park in a rapidly developing urban community. Unfortunately, the Lake was originally incorporated into Scajaquada Creek, which has its source east of Buffalo in the Town of Lancaster and flows westward through the Town of Cheektowaga and the City of Buffalo into the Black Rock Canal and ultimately into the Niagara River. The unified Lake and Creek arrangement must have seemed like a very attractive engineering design in 1870. It allowed for the birth of a man-made lake with freshwater continually flowman-made lake with freshwater continually flowing through it in a verdant park area. From its very beginning, the Lake area became a city-wide attraction for individual and group recreation. The same problems that plagued the Lake in recent times have been associated with it since the 1870's, e.g. sewage entering the Lake from upstream, the tidal effects of Black Rock Canal, floating debris and erosion of the banks. These conditions culminated in the closing of the Lake in 1958 when the Erie County Health Department declared it a health hazard. This report briefly summarizes the Delaware Park Lake Revitalization Project which began in 1973, with the initial study and was completed in 1984 with the final phase of construction. Restoration efforts involved a re-routing of sewers, slope protection, dredging, investigation of sewers, slope protection, dredging, investigation of alternate make-up water sources, dam modifications, and the use of by-pass conduits to pass the Creek around the lake. The construction of these Creek around the lake. The construction of these features reduced the number of overflow events in 1981-1984 from the expected 15 events to 8, 3 of which were significant. The various reports prepared during the project and the planning, design and construction phases are briefly described.

CALIFORNIA DIVISION OF OIL AND GAS UNDERGROUND INJECTION CONTROL UNDERGROUND INJECTION PROGRAM: A PEER REVIEW.

Underground Injection Practices Council, Oklahoma City, OK.
For primary bibliographic entry see Field 5E.
W90-07499

BIOLOGICAL TESTING OF SEDIMENT FOR THE OLYMPIA HARBOR NAVIGATION IM-PROVEMENT PROJECT, 1988: GEODUCA AMPHIPOD, AND ECHINODERM BIOAS-

Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab. For primary bibliographic entry see Field 5C. W90-07500

COEUR D'ALENE BASIN - EPA WATER QUALITY MONITORING, 1972-1986. Environmental Protection Agency, Seattle, WA.

Region A. Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-217962. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA 910/9-88-216, September 1988. 32p, 16 fig, 11 tab, 2 maps, 27 ref.

Descriptors: *Coeur d'Alene River, *Idaho, *Mine wastes, *Monitoring, *Path of pollutants, *Water pollution control, *Water pollution sources, Bioaccumulation, Cadmium, Fish, Heavy metals, Lead, Low flow, Sediment contamination, Streamflow, Tissue analysis, Zinc.

Chemical and biological monitoring during low-flow conditions from 1972 to 1986 along the South Fork Coeur d'Alene River in northern Idaho, a stream with a long history of severe metals pollu-tion from mining activities. During 1986, metals analysis of sediments and tissues from the lower Coeur d'Alene River and Coeur d'Alene Lake was also conducted. Due chiefly to effluent controls at

Water Quality Control-Group 5G

the Bunker Hill Complex, low-flow season South Fork concentrations of zinc, cadmium, and lead downstream of Kellogg were reduced during the 1970's from 13.6 mg/L, 0.24 mg/L, and 0.75 mg/L, to levels of 5.0 mg/L, 0.03 mg/L, and 0.03 mg/L, respectively. During the 1986 low-flow survey, metal loadings were primarily a result of nonpermitted inputs to the stream, chiefly from the vicinity of the Bunker Hill Central Impoundment Area and from Canyon Creek, a tributary near Wallace. the Bunker Hill Central Impoundment Area and from Canyon Creek, a tributary near Wallacc. Although levels of zinc and cadmium remain well above national criteria for protection of cold water of the Coeur d'Alene, recovery of aquatic life has been substantial, with the lower mainstem now supporting a successful sports fishery. Sediments in the lower Coeur d'Alene system remain heavily contaminated with toxic metals, although high levels in edible fish tissue were not found. In terms of immediate benefits to the mainstem biota, the cessation or treatment of the major discrete CIA seep at the Bunker Hill Superfund Site is estimated to reduce mainstem summer low-flow zinc concentrations by 5 150 micrograms/L. Allowable permit limits (as of 1986) for metals (primarily cadmium) have the potential of increasing instream metals concentrations substantially above the levels resulting from nonpermitted sources. stream metas concentrations substantially above the levels resulting from nonpermitted sources. Water quality based permits are particularly im-portant for aquatic life protection of the South Fork upstream of Mullan and the mainstem down-stream of the South Fork confluence. Water quality management should take a basin-wide, integrated approach that considers effects on downstream reaches from upstream sources. ea approach that considers effects on downstream reaches from upstream sources, cost of rehabilita-tion of mine tailings and control of seeps, further control of point and nonpoint sources, and habitat recovery. (Author's abstract) W90-07504

HORIZONTAL WELLS FOR IN-SITU REMEDIATION OF GROUNDWATER AND SOILS, Savannah River Lab., Aiken, SC.

D. S. Kaback, B. B. Looney, J. C. Corey, L. M. Wright, and J. L. Steele.

wright, and J. L. Steele.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE89-010456. Price codes: A03 in paper copy, A01 in microfiche. Report No. DP-MS-88-230, 1989. 15p, 6 fig, 1 ref. DOE Contract DE-AC09-76SR00001.

Descriptors: *Cleanup operations, *Groundwater pollution, *Horizontal wells, *In situ treatment, *Soil contamination, *Water pollution treatment, Injection wells, Vadose zone, Volatile organic

Two horizontal wells were installed adjacent to an abandoned process sewer line at the Savannah River Plant. Documented leaks from the process sewer have contaminated the underlying vadous zone and groundwater with volatile organic compounds. The wells were installed to test new methpounds. I he wells were installed to test new metin-ods of in-situ remediation of soils and groundwater. A deep horizontal well, installed below the water table, is to be used as an air-injection well to strip volatile organics from the contaminated groundwater. The shallow horizontal well, ingroundwater. The shallow horizontal well, in-stalled in the vadose zone, is to be used to remove vapor-phase volatile organic compounds (VOCs) from the vadose zone and to recover the organics purged from the groundwater. Horizontal wells were selected for injection and extraction because this geometry should maximize the surface area available for in-situ remediation reactions to occur. Target zones for the lateral well screens were selected on the basis of: (1) concentrations of Target zones for the lateral well screens were selected on the basis of: (1) concentrations of VOCs in groundwater from nearby monitoring wells; and (2) porosity and permeability of the sediments as determined by core analysis, geophysical logs, and sieve analyses. Short-radius directional drilling tools and a mud rotary drilling system were used to install the wells. Important factors when drilling in shallow unconsolidated sediments are: (1) minimization of the number of trips in and out of the borehole; (2) maximization of drilling fluid performance by using a fluid of low solids, low weight, moderate viscosity, and high lubricity; (3) selection of well materials with adequate flexibility and strength; and (4) selection of drilling targets in zones with a minor component

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G-Water Quality Control

of clay to improve formation cohesiveness and thus improve drilling performance. (Author's abstract) 90-07506

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

POLICY IMPACTS ON AGRICULTURAL IRRIGATION ELECTRICITY DEMAND IN THE COLUMBIA BASIN.

COLLUMBIA BASIN. Oregon State Univ., Corvallis. M. Martin, L. Cox, S. Nakamoto, and J. Halloran. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 35-39, February 1990. 1 fig. 10 ref.

Descriptors: *Elasticity of demand, *Electrical demands, *Energy costs, *Irrigation, Columbia River Basin, Costs, Operating policies.

Accurately estimating the price elasticity of demand for irrigation electricity is important to major electricity suppliers such as the Bonneville Power Administration (BPA) of the Pacific Northwest. The BPA has a revenue maximization objective, and the elasticity of demand is central to its tive, and the elasticity of demand is central to its rate setting process. Several studies have attempted to estimate demand for irrigation electricity, but none has explicitly included federal agricultural policy and program variables. Agricultural pro-grams may influence farmers' irrigation decisions and thus their demand for irrigation electricity. Existing programs serve to make farmers more responsive to electricity rate increases than would otherwise be the case. Thus, studies that fail to include them may underestimate the responsiveness of farmers to electricity rate increases. (Author's abstract) Wanneson

ARGE DAMS: IMPLICATIONS OF IMMOR-TALITY.

Leyland Consultants Ltd., Auckland (New Zea-For primary bibliographic entry see Field 8A. W90-06875

NEED FOR COMPUTER-ASSISTED HYDROG-

RAPHY. E and S Computer Systems, Inc., Sparta, NJ. For primary bibliographic entry see Field 7C. W90-07103

ESTIMATION OF POTENTIAL REDUCTIONS IN RECREATIONAL BENEFITS DUE TO SEDIMENTATION.

Salisbury State Coll., MD. Perdue School of Busi-

For primary bibliographic entry see Field 4C. W90-07215

ENVIRONMENTAL IMPACT ASSESSMENT: THE GROWING IMPORTANCE OF SCIENCE IN GOVERNMENT DECISION MAKING. Environmental Assessment Review Office, Hull

(Quebec). R M Robinson

Hydrobiologia HYDRB8, Vol. 188/89, p 137-142, December 1989. 8 ref.

Descriptors: *Canada, *Environmental impact, *Environmental policy, *Environmental protection, *Multiobjective planning, *Planning, Bioassay, Brundtland Report, Public participation.

The broad acceptance of the conclusions and rec-ommendations contained in the Brundtland Report with its emphasis on environmentally sustainable development is a good indication that this concept is gaining world-wide recognition. Science and the ensuing technology must be credited for creating and sustaining modern society and expertise must now be applied to minimize the adverse impacts of industrial growth and preserve the environment.

Real progress towards the reconciliation of eco-Real progress towards the reconciliation of eco-nomic and environmental goals will require effec-tive incorporation of environmental impact assess-ment (EIA) into the planning process. In 1973, Canada established the Environmental Assessment and Review Process (EARP) to ensure that the environmental consequences of federal govern-mental activities are assessed early in the planning mental activities are assessed early in the planning stage before any commitments or irrevocable deci-sions are made. The EARP can involve up to three sequential review stages; screening, initial assess-ment, and public review. Public trust and partici-pation in the process are key ingredients for the success of meeting environmental goals as well as success of meeting environmental goals as well as good science and meaningful dialogue between the scientists, the public and the decision makers. The availability of standard and reliable bioassessment techniques should be helpful in strengthening the scientific basis for biophysical aspects of EIA. (Author's abstract) W90-07259

6B. Evaluation Process

BRAZIL'S BALBINA DAM: ENVIRONMENT VERSUS THE LEGACY OF THE PHARAOHS IN AMAZONIA.

Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil). Dept. of Ecology. For primary bibliographic entry see Field 6G. W90-06607

HYDROPOWER IN NEW ENGLAND: AN IN-TRODUCTION.

J.R. Ehrenfeld. Vermont Law Review, Vol. 5, No. 2, p 189-199, Fall 1980, 3 tab.

Descriptors: *Hydroelectric power, *New England, *Regional planning, *Water resources development, Dam effects, Economic aspects, Environmental effects, Social aspects.

The basic low-head hydropower system has potential as an energy source in New England. Nearly till as an energy source in New England. Nearly 11,000 dams currently exist there. Three hundred sixty-three of them are currently used to generate electricity, 53 dams were built by the Corps of Engineers exclusively for flood control, and 1445 of the dams are wholly or partially breached. Hydropower at existing dams will not be a panace of the New England of the Control of the rygropower at existing dams will not be a panacea for New England's energy problems. Development of the 200 most-favorable existing dam sites would only provide savings of about 2.7 million barrels of oil per year. This saving is minimal when compared with the 75 million barrels of oil consumed in 1978 to produce electricity in New England. Even the most optimistic estimates indicate that development of New England's maximum hydrodevelopment of New England's maximum hydro-power potential would provide only about 1000 MW of capacity or seven percent of the region's 1978 winter peak load. If hydropower is to be developed in New England, sites with economic potential must be identified and willing buyers found. As development occurs, water management problems, river use conflicts, and environmental impacts associated with hydropower will appear impacts associated with hydropower will appear with greater frequency. These impacts on a river system will create social consequences which must be considered in the development of hydro facilities. The following policies should be developed to balance the various uses of the rivers. (1) A framebalance the various uses of the rivers: (1) A frame-work for negotiating instream flow requirements. (2) A process for identifying which recreational and pristine river segments should be included in the federal or state Wild, Scenic and Recreational Rivers Systems. (3) An examination of anadromous fish restoration plans to evaluate the costs and restraints placed on overall hydro development; this evaluation should include consideration of hy-dropower benefits in addition to fishery benefits in developing the list of rivers to be restored. (4) A study of existing flood-control structures to determine the tradeoffs between protection, flooding, and hydro generation that are feasible and acceptable. (Author's abstract) W90-06699

RENEWAL THEORY CRITERIA OF EVALUA-TION OF WATER-RESOURCE SYSTEMS: RE-LIABILITY AND RESILIENCE.

Polish Academy of Sciences, Warsaw. Inst. of Geophysics. Z. W. Kundzewicz.

Nordic Hydrology NOHYBB, Vol. 20, No. 4/5, p 215-230, 1989. 3 fig, 18 ref.

Descriptors: *Poland, *Water resources develop-ment. *Water resources management. *Water ment, *Water resources management, *Water supply development, Planning, Population dynamics, Simulation studies, System design, Water

Water-resource systems serve increasingly de-manding and risk averse societies. Therefore, in addition to the traditional measures of quality of performance of water-resource systems like mean performance of water-resource systems like mean or variance of benefits or some operational variable, other criteria are also needed, that quantify various aspects of reliability and risk-recurrence, duration, severity and consequences of nonsatisfactory system performance. A resilient system should be able to accommodate a surprise (similar notions-insensitivity, robustness). Ordering the many different measures of reliability and resilience can be attained basing on the level excursion (crossing) theory or the renewal theory. In the present stage of research two case studies are being analyzed, pertaining to water supply systems in Poland. Hydrological records (flows in rivers) and projections of water demands are used to generate resistance of water demands are used to generate resistance and load variables. The indicator variables are analyzed for several conditions on resistance (without reservoir, with reservoir-in several variants) and on demand (several scenarios of demand and on demand (several scenarios of demand growth, resulting from different forecasts of population growth, regional development and water consumption standards). Studies of reliability and resilience are being performed, using renewal theory (Markovian methodology in stationary and nonstationary cases) and level crossings (excursions) theory. It should be stressed, however, that the station of the stressed of the statement of reliability and resilience measures do not exhaust the set of important performance indices of waterthe set of important performance indices of water-resource systems. In fact, indices of vulnerability (measuring amplitude, i.e., severity of system entry into the nonsatisfactory state) and robustness (measuring system sensitivity to the location of the border between the nonsatisfactory and the satis-factory system performance) are of great impor-tance. Therefore the complete problem formula-tion requires a multi-objective framework. (Au-thor's abstract)

ECONOMIC EFFECTS OF RIVER RECREA-TION ON LOCAL ECONOMIES. H. K. Cordell, J. C. Bergstrom, G. A. Ashley, and

Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 53-60, February 1990. 7 tab, 9 ref, append.

Descriptors: *Economic aspects, *Recreation, *Rivers, *Tourism, Input-output analysis, Model studies, Rate of return, Water resources develop-

Outdoor recreation is a major, growing use of water resources in the United States. The economic effects of expenditures by visitors to three recreational river sites on local economies surrounding the sites were estimated using an input-output model. Expenditure data were from the Public Area Recreation Visitors Study. Results indicate that visitor spending stimulates a considerable amount of economic activity and growth in local economies. Economic effects include increases in economies. Economic effects include increases in total gross output ranging from 52.6 million to \$13.4 million, increases in total income ranging from \$1.2 million to \$5.6 million, and increases in employment ranging from 60 to 292 jobs. (Author's abstract)

NETWORK DESIGN FOR WATER SUPPLY FORECASTING IN THE WEST.

Hydex, Inc., Vienna, VA.
For primary bibliographic entry see Field 7A.

W90-06826

CHARGES FOR URBAN RUNOFF: ISSUES IN

IMPLEMENTATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of
Geography and Environmental Engineering.
For primary bibliographic entry see Field 5G. For primar W90-06828

ECONOMIC FRAMEWORK FOR FLOOD AND SEDIMENT CONTROL WITH DETENTION

Maryland Univ., College Park. Dept. of Civil En-For primary bibliographic entry see Field 4A. W90-06831

SAMPLING STOCHASTIC DYNAMIC PRO-GRAMMING APPLIED TO RESERVOIR OP-EDATION

Centro de Pesquisas de Energia Eletrica, Rio de For primary bibliographic entry see Field 4A. W90-06853

UNDERSTANDING THE RESPONSE TO ENVI-RONMENTAL RISK INFORMATION.

Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies

J. Vining. IN: Biohazards of Drinking Water Treatment. Lewis Publishers, Chelsea, Michigan. 1989. p 21-

Descriptors: *Communication, *Decision making, *Public policy, *Risk assessment, *Water pollution, Drinking water, Environmental impact, Information exchange, Risks, Water quality.

As the list of toxic and hazardous substances in drinking water has lengthened, the problem of communicating the risks attributable to those subdrinking water has lengthened, the problem of communicating the risks attributable to those substances to the public has become critical. When the public is presented with information about the risks of environmental hazards, the variety of responses is often bewildering. However, there are consistencies in people's responses to risk. In general, people consistently use a variety of strategies to simplify gathering and processing information to make a decision; it is important to recognize the functional value of these strategies. Two basic psychological principles, derived from the learning theory of Skinner and psychoanalytic theory of Freud, provide some insight into the way people may respond to risk information. In evaluating risk information and arriving at a decision as to the proper course of action people often use a variety of cognitive or intellectual strategies to ease the stress burden. The emotional and intuitive properties of the response to risk are increasingly being examined. Some recommendations can be made concerning the communication of environmental risk information to the public. It is important to allow the complexity munication of environmental risk information to the public. It is important to allow the complexity of risk information to enter into the judgment process. While preserving complexity, information should be provided in a format that people can understand and manage. It is probably best to be the first to make a balanced and comprehensible presentation of the risks people are asked to accept. It is important to recognize the influence of emo-tion and intuitive factors and individual differences in preferences and judgmental styles. (See also in preferences and judgmental styles. (See also W90-06906) (Fish-PTT) W90-06908

INTEGRATED USE OF NATURAL RE-SOURCES AND GEOENVIRONMENT.

Stavebni Geologie, Prague (Czechoslovakia). Hy-

drogeology Dept. For primary bibliographic entry see Field 6G. W90-06958

MANAGEMENT AND FEASIBILITY OF RE-VERSE OSMOSIS SCHEMES FOR RURAL WATER SUPPLY IN INDIA. Bhabba Atomic Research Centre, Bombay (India).

Desalination Div.

For primary bibliographic entry see Field 3A. W90-07433

DEVELOPMENT AND APPLICATION OF A ROOF TYPE SOLAR STILL.
Nagoya Univ. (Japan). Dept. of Chemical Engi-

For primary bibliographic entry see Field 3A.
W90-07438

PERFORMANCE RATIO, AREA ECONOMY AND ECONOMIC RETURN FOR AN INTE-GRATED SOLAR ENERGY/MULTI-STAGE FLASH DESALINATION PLANT. Panjab Univ., Chandigarh (India). Dept. of Chemi-cal Engineering.

Fanjab Oliv., Chandigain (India). Dept. of Ci cal Engineering. For primary bibliographic entry see Field 3A. W90-07443

STUDY OF THE OPERATING CONDITIONS FOR THREE LARGE MSF DESALINATION UNITS EACH OF CAPACITY 7.2/8.6 MGD (27360/32832 TON/DAY) IN ABU DHABI, UAE. El Saie (M.H.A.), Cairo (Egypt).
For primary bibliographic entry see Field 3A.
W90-07445

BELGARD EV-15 YEARS' EXPERIENCE IN

SCALE CONTROL.
CIBA-GEIGY Plastics and Additives Co., Manchester (England). Industrial Chemicals Div. For primary bibliographic entry see Field 3A. W90-07453

OPERATING EXPERIENCE OF MSF DESALI-NATION PLANT AT THE ABU KAMMASH CHEMICAL COMPLEX. Alfatch Univ., Tripoli (Libya). Dept. of Civil En-

For primary bibliographic entry see Field 3A. W90.07459

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

TECHNOECONOMICS OF POWER/DESALT-ING COGENERATION PLANTS IN KUWAIT-A PRELIMINARY STUDY. Kuwait Water Resources Development Control

Kuwait Water Resources Development Centre, Safat. For primary bibliographic entry see Field 3A. W90-06566

OPTIMIZATION OF DUAL-PURPOSE STEAM POWER AND MSF DESALINATION PLANT. Consulting Engineers, P.O. Box 223, Heliopolis,

Coiro, Egypt.
For primary bibliographic entry see Field 3A.
W90-06567

OPTIMUM DESIGN FOR A HYBRID DESALT-ING PLANT

King Saud Univ., Riyadh (Saudi Arabia). Coll. of Engineering.
For primary bibliographic entry see Field 3A.
W90-06568

COSTS OF SEAWATER DESALINATION IN REAL TERMS, 1979 THROUGH 1989, AND PROJECTIONS FOR 1999.

Leitner and Associates, Inc., Elm Grove, WI. For primary bibliographic entry see Field 3A. W90-06570

COMPREHENSIVE STUDY ON CAPITAL AND OPERATIONAL EXPENDITURES FOR DIF-FERENT TYPES OF SEAWATER DESALTING PLANTS (RO, MVC, ME, ME-TVC, MSF) RATED BETWEEN 200 CUBIC M/D AND 3000 CUBIC M/D.

TRACTEBEL S.A., Brussels (Belgium). For primary bibliographic entry see Field 3A.

W90-06571

PARAMETRIC COST ANALYSIS STUDY OF SEAWATER REVERSE OSMOSIS SYSTEMS DESIGN IN KUWAIT.

Kuwait Water Resources Development Centre. For primary bibliographic entry see Field 3A. W90-06572

TECHNICAL AND ECONOMICAL COMPARISON BETWEEN LARGE CAPACITY MSF AND RO DESALTING PLANTS,

Kuwait Univ., Safat. Dept. of Mechanical Engi-

For primary bibliographic entry see Field 3A. W90-06573

TECHNICAL ASPECTS OF REDUCING DE-SALTING WATER COST BY DISTILLATION METHODS.

Kuwait Univ., Safat. Dept. of Mechanical Engineering. For primary W90-06574 ary bibliographic entry see Field 3A.

PROBLEMS ENCOUNTERED IN THE HOTWELLS DISTRICT SMALL-SCALE ME-TERING TRIAL.

Bristol Waterworks Co. (England). For primary bibliographic entry see Field 5F.

ECONOMIC EFFECTS OF RIVER RECREA-TION ON LOCAL ECONOMIES.
For primary bibliographic entry see Field 6B. W90-06822

DESIGN AND COST ESTIMATES FOR A CON-DESIGN AND COST ESTIMATES FOR A CON-NECTING CHANNEL BETWEEN EAST DEVILS LAKE AND WEST STUMP LAKE, DEVILS LAKE BASIN, NORTH DAKOTA. Barr Engineering Co., Minneapolis, MN. For primary bibliographic entry see Field 8A. W90-07468

6D. Water Demand

TRADE-OFF ANALYSIS OF ALTERNATIVE WATER USES.

Idaho Univ., Moscow. Dept. of Agricultural Eco-R. B. Long.

Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 157-166, February 1990. 9 fig, 8 ref.

Descriptors: *Economic aspects, *Hydroelectric power, *Idaho, *Irrigation requirements, *Water use, Costs, Flow variation, Snake River.

In the western United States, hydropower and agriculture often compete for surface waters. Since water markets are imperfect, allocations are often made through institutional arrangements and policy. The purpose of this paper is to compare the gross water returns from agriculture with hydropower in terms of water use in Idaho. For the year 1986, returns from agriculture averaged \$200 per acre-foot, and returns from hydropower averaged \$8.00 per acre-foot. Water used by irrigated agriculture out produces hydropower by a ratio of 10 o 1 even when producer prices are used for agriculture and consumer prices for hydropower. In addition, river flow variations on the lower end of the Snake River at Weiser are unrelated to Upper Snake irrigation diversions. While an average of \$5. million acre-feet are diverted, as little as 2.3 In the western United States, hydropower and 8.5 million acre-feet are diverted, as little as 2.3 8.5 million acre-feet are diverted, as fitte as 2.5 million acre-feet of water may be consumed by irrigation on the Upper Snake. It is apparent that reallocation of water from agriculture to hydropower would not increase either income or renloyment in southern Idaho. (Author's abstract)

Field 6—WATER RESOURCES PLANNING

Group 6D-Water Demand

FARM PROGRAM IMPACTS ON AN EX-HAUSTIBLE GROUNDWATER SUPPLY: AN ANALYSIS OF THE TEXAS SOUTHERN HIGH PLAINS.

PLANS.
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusiness.
J. G. Lee, and R. D. Lacewell.

Water Resources Research WRERAQ, Vol. 26, No. 3, p 361-368, March 1990. 7 fig. 24 ref.

Descriptors: *Cost analysis, *Crop yield, *Ground-water management, *Irrigation requirements, *Model studies, *Stochastic models, *Water demand, Texas.

Stochastically simulated crop yields were com-bined with random correlated crop prices to pro-vide input into a recursive quadratic programming model to evaluate optimal irrigated crop selection and associated rates of groundwater withdrawals. Three farm program scenarios were evaluated in two areas of the Southern High Plains. Participation in the current farm program increased net returns and groundwater extraction rates above nonparticipation. Discounted net returns were prononparticipation. Discounted net returns were pro-jected to decline across all farm program scenarios. Risk averse preferences in crop mix decisions de-creased cumulative groundwater extraction rates through reduced irrigated acres but had higher per acre application rates compared with the risk ne tral case. (Author's abstract)

INTEGRATION OF SURFACE AND GROUND-WATER RESOURCES FOR THE DEVELOP-MENT OF HAMAD BASIN PROJECT.

Arab Center for the Studies of Arid Zones and Dry Lands, Damascus (Syria).
For primary bibliographic entry see Field 4B.
W90-06960

CLASS OF TIME SERIES URBAN WATER DEMAND MODELS WITH NONLINEAR CLI-MATIC EFFECTS

Tennessee Univ., Knoxville. Energy, Environment and Resources Center. S.-P. Miaou.

Water Resources Research WRERAQ, Vol. 26, No. 2, p 169-178, February 1990. 4 fig, 4 tab, 17

Descriptors: *Model studies, *Time series analysis, *Urban water demand, *Water demand, Climates, Comparison studies, Hysteresis, Mathematical models, Precipitation, Seasonal variation, Temperature, Texas, Urbanized areas.

A new class of monthly time series urban water demand model is proposed. The model postulates that water use is made up of base use and seasonal use: and the latter consists of three components: a use; and the latter consists of three components: a potential use that is dependent on temperature in the absence of rainfall, a water use reduction due to rainfall occurrences, and a random component. The proposed model utilizes three observations that were established in daily water use studies: (1) 'hysteresis' temperature effect: under the same temhysteresis temperature enter tinuer in same tem-perature, water use has different levels and re-sponse rates (to a unit change of temperature) in different seasons; (2) 'dynamic' rainfall effect: a rainfall causes temporary reduction in seasonal use characteristics and averaging a daily response model. The gating and averaging a daily response model. The model so obtained is nonlinear in structure. The model so obtained is nonlinear in structure. Ine performance of the model was compared with conventional linear models using data from Austin, Texas, from 1975 to 1984. The proposed nonlinear models outperform the linear models in describing seasonal water use variations in terms of adjusted R squared, Akaike information criterion value, and ability to estimate the high summer use in dry and wet years. (Author's abstract) W90-07347

DETERMINANTS OF HOUSEHOLD WATER CONSERVATION RETROFIT ACTIVITY: A

DISCRETE CHOICE MODEL USING SURVEY

California Univ., Los Angeles. Dept. of Econom-

ics.
T. A. Cameron, and M. B. Wright.
Water Resources Research WRERAQ, Vol. 26,
No. 2, p 179-188, February 1990. 5 tab, 27 ref.
Water Resources of the University of California
Project W-708.

Descriptors: *Economic aspects, *Urban water demand, *Water conservation, *Water demand, Attitudes, California, Cost analysis, Household plumbing, Los Angeles, Retrofits, Surveys.

Economic analyses of residential water demand typically have concentrated on price and income elasticities. In the short run a substantial change in elasticities. In the short run a substantial change in water prices might induce only small changes in consumption levels. As time passes, however, households will have the opportunity to 'retrofit' existing water-using equipment to make it less water-intensive. This produces medium-run to long-run demand elasticities that are higher than short-run studies suggest. Responses to water con-servation questions appearing on the Los Angeles Department of Water and Power's 1983 residential energy survey were examined. It was found that households' decisions to install shower retrofit devices are influenced by the potential to save money on water heating bills. Toilet retrofit decisions are on water neating bills. I ouer retrofit decisions are attributed more to non-economic factors, which might be characterized as a 'general conservation mindedness.' The endogeneity of these retrofit de-cisions casts some doubt on the results of studies of individual households that treat voluntary retrofits as exogenous. (Author's abstract) W90-07348

6E. Water Law and Institutions

LOCAL GOVERNMENT POLICIES TOWARDS ENVIRONMENTALLY SENSITIVE AREAS IN BRITISH COLUMBIA, CANADA; WASHINGTON AND OREGON, USA.
Washington State Univ., Pullman. Program in Environmental Science and Regional Planning.
M. D. Jennings, and J. P. Reganold.
Environmental Management EMNGDC, Vol. 13, No. 4, p 443-453, July/August 1989. 2 fig, 7 tab, 62 ref.

Descriptors: *Environmental policy, *Land use, *Local governments, *Policy making, *Regulations, Canada, Long-term planning, Oregon, Public policy, Species diversity, State jurisdiction, Wash-

While there has been sustained debate on the issue of provincial and state versus local government environmental planning, maintaining privately owned natural resources in the public interest is increasingly viewed as beyond the scope of local governments alone. This paper describes and com-pares province-level and state-level mandates and options for local governments (i.e., city, county, or district) to regulate land uses of environmentally sensitive areas (ESAs) in British Columbia in Canada and in Washington and Oregon in the sensitive areas (ESAs) in British Columbia in Canada and in Washington and Oregon in the United States. ESAs are defined as landscape elements or places that are vital to the long-term maintenance of biological diversity, soil, water, and other natural resources, especially as they relate to human health, safety, and welfare, both on-site and in a regional context. Underlying similarities are that all three jurisdictions legally express the need for land-use planning by local governments in managing ESAs. Although all three jurisdictions exhibit similar problems in their attempt to accomplish this, ESA planning by local governments is an optional process in British Columbia and Washington but mandatory in Oregon. Furthermore, actual processes prescribed by each of the three jurisdictions are quite different. The information base upon which local regulation of privately held ESAs depends is variable, both within and between the province-level and statelevel jurisdictions. Other than for some specific water-related resources, standard definitions and inventory methods for ESAs are lacking, as is coordination among local governments or among

the province-level and state-level governments. This study concludes that there is a need for a regional environmental information system in the Pacific Northwest based upon an integrated and scientific approach toward ESA structures and functions. (Author's abstract) W90-06608

IDENTIFYING TOXICANTS: NETAC'S TOXIC-ITY-BASED APPROACH.

National Effluent Toxicity Assessment Center, Duluth, MN. For primary bibliographic entry see Field 5A. W90-06662

HYDROPOWER IN NEW ENGLAND: AN INTRODUCTION.

For primary bibliographic entry see Field 6B. W90-06699

COMMON LAW OF WATERPOWER IN NEW ENGLAND.

Washington and Lee Univ., Lexington, VA. D.J. Brion. Vermont Law Review, Vol. 5, No. 2, p 201-249, Fall 1980, 207 ref.

Descriptors: *Common law, *History, *New England, *Water law, Competing use, Energy sources, Riparian rights, Riparian waters.

Due to the geography and hydrology of the New England area an abundance of sites existed along its many watercourses which were useable for waterpower. Much of this potential was intensivewaterpower. Much of this potential was intensively developed and there were frequent conflicts among waterpower users. Under these circumstances, the New England courts generated a substantial proportion of the judicial decisions dealing with the right of a riparian owner to develop the waterpower of a stream. The common law doctrines of riparian law which govern the development by a private individual of the power potential of a natural watercourse evolved during the nineteenth century heyday of waterpower before the growth of the administrative state in this century. On the whole, the pattern of private rights which has evolved is favorable to the waterpower developer. The rights of competing waterpower developer. oper. The rights of competing waterpower devel-opers have also been extensively litigated. Federal and state statutes and regulations now define a relationship between the waterpower developer and government. Riparian law, however, continues and government. Riparian law, however, continues to define the relationship between the waterpower developer and other holders of water-use rights. Although the common law of waterpower is primarily a product of nineteenth-century adjudication, it would be incorrect to conclude that this law is obsolete. On the contrary, these nineteenth-century doctrines should continue to work today. Riparian law is still relevant to the limitations imposed on the exercise of private water rights by the public's interest in and prerogatives over natural water (Mele-PITO). the public's interest in and prerogatives over ral waters. (Male-PTT) W90-06700

SMALL HYDROPOWER DEVELOPMENT AND THE ENVIRONMENT: A SURVEY OF STATE AND FEDERAL LAW. B.D. Scotch.

Vermont Law Review, Vol. 5, No. 2, p 251-278, Fall 1980, 135 ref.

Descriptors: *Environmental policy, *Hydroelectric power, *Interagency cooperation, *Water law, Environmental protection, Federal jurisdiction, Vermont.

In 1946, the US Supreme Court squarely settled the preemptive authority of the Federal Power Act over construction of essentially all hydroelectric generating facilities. Yet state regulation has not faded in the face of undoubted federal supremacy, and in the 1980s not even the Federal Energy Regulatory Commission (FERC) denies that dual federal and state authority is well-established and may even grow. The balance between state and federal authority in the regulation of hydroelectric

WATER RESOURCES PLANNING—Field 6

Nonstructural Alternatives—Group 6F

power project licensing continues to be uncertain. In Vermont the Public Service Board considers, by In Vermont the Public Service Board considers, by statute, all proposed electric generating facilities, including hydropower facilities. The Vermont Agency of Environmental Conservation (AEC) is responsible for the administration of almost all elements involving air and water purity and the natural environment. Except in pollutant discharge cases the AEC and other state and local agencies cases the AEC and other state and local agencies are, however, limited to an advisory and technical role. Nonetheless, with renewed emphasis on small hydropower development and broader expressions of support for a greater state presence in federal/ state cooperative programs generally, it appears unlikely that the FERC will seek to eliminate state review altogether, at least where there is no at-tempt to encroach on federal authority. Although numerous federal environmental statutes affect hydropower development generally, early consulta-tion with agency officials will minimize possible conflicts and administrative delays. A comprehen-sive, cooperative state and federal effort to develop waterpower will prove to be the best approach to a dependable and environmentally-acceptable hydroelectric system. (Author's abstract)

ROLE OF THE FEDERAL ENERGY REGULA-TORY COMMISSION IN LICENSING SMALL HYDROELECTRIC PROJECTS.

Vermont Law School, South Royalton. T.M. Debevoise. Vermont Law Review, Vol. 5, No. 2, p 279-292, Fall 1980. 70 ref.

Descriptors: *Administrative agencies, *Federal jurisdiction, *Hydroelectric power, *Licensing, Administrative regulations, Energy sources, Legal aspects. Water law

The Public Utility Regulatory Policies Act of 1978 (PURPA), contains provisions designed to encourage the development of electricity by waterpower, age the development of electricity by waterpower, a renewable resource. Since the general rule is that hydroelectric projects require a license for con-struction and operation from the Federal Energy Regulatory Commission (FERC), interest in the jurisdiction and procedures of that agency has recently increased. FERC's jurisdiction over hydroelectric projects originated in the Federal Water Power Act of 1920, now part I of the Federal Power Act, it is perhaps easiest to remem-ber the reach of the FERC jurisdiction if one starts with the proposition that, subject to a few excep-tions in arid areas, the water in all streams in the country originates in watersheds of navigable rivers. The United States has jurisdiction over streams in such watersheds to protect its interests in navigable waterways under the commerce clause. A developer who believes that a proposed clause. A developer who believes that a proposed project does ont require a FERC license must nevertheless file with FERC a 'Declaration of Intention'. Once it has been determined that a FERC license is required, it is necessary to ascertain under which set of regulations application should be made. There are separate regulations for each of the following extensions: (1) projects under should be made. There are separate regulations for each of the following categories: (1) projects under 2000 hp (1500 kW), proposed and existing but never licensed; (2) projects larger than 2000 hp, proposed and existing but never licensed; (3) projects larger than 2000 hp at existing but unlicensed dams where there will be 'no significant environmental impact; and (4) projects of no more than 15,000 kW which make use of a water conduit operated primarily for nonpower purposes. (Author's abstract)

IMPACT OF ECONOMIC AND FINANCIAL POLICIES ON THE DEVELOPMENT OF SMALL-SCALE HYDROGLECTRIC FACILITIES IN NEW ENGLAND.
Thayer School of Engineering, Hanover, NH.
D.R. Lynch, and P.H. Kirshen.
Vermont Law Review, Vol. 5, No. 2, p 295-312, Fall 1980. 3 fig, 51 ref.

Descriptors: *Computer models, *Economic prediction, *Hydroelectric power, *Regional development, Dynamic programming, Economic impact, Financial feasibility, Hydroelectric plants.

In 1978 a study of the factors influencing small-scale hydro (SSH) development in the nineteen northeastern states was undertaken. Two computer models were developed to assist in this quantitative study; both use the system dynamics approach to simulate the time-dependent effects of the many factors which influence development. The first model-HYDRO-I--uses a supply curve along with financial parameters. The simulation results indiinancial parameters. The simulation results indicate a decrease in installed capacity from approximately 670 MW in 1960 to 620 MW in 1975, which approximates historical data. According to HYDRO-I, SSH redevelopment begins in 1977. By the year 2000 project initiation has dropped substantially, and installed capacity has begun to level off in the neighborhood of 1000 MW. Using this projection as a point of reference, HYDRO-I was used to assist in preparation of testimony for the US Senate Finance Committee. Although qualitatively ranking the effect of policy changes on installed capacity tends to be insensitive to changes in model parameters, the details of HYDRO-I predictions do in fact depend heavily on several assumptions. For this reason, an improved estimate for the supply curve for existing dams has been for the supply curve for existing dams has been incorporated into a refined model, HYDRO-II. As a point of reference, it was assumed that beginning in 1980, the price paid for SSH would be set by m 1760, the price paid for SSH would be set by state public utility commissions at 65 mills/kWh for firm power and 60 mills/kWh for nonfirm power, in accord with the Public Utility Regula-tory Policies Act of 1978. The model results are quite indifferent to reasonable changes in the state property tax rate because of the small percentage of annual costs required to cover this tax. (Author's abstract) W90-06703

WATER SOURCE PROTECTION AND PROTECTION ZONES.

For primary bibliographic entry see Field 5G. W90-06712

LAND DRAINAGE: AGRICULTURAL BENE-FITS AND ENVIRONMENTAL IMPACTS. For primary bibliographic entry see Field 3F. W90-06713

REGULATORY REQUIREMENTS AFFECTING AQUIFER THERMAL ENERGY STORAGE

Battelle Pacific Northwest Labs., Richland, WA. P. L. Hendrickson.

Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 81-85, February 1990. 18 ref. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Regulations, *Thermal energy, *Underground storage, Aquifers, Groundwater withdrawal, Permits, Thermal pollution, Water use.

Thermal energy storage involves the capture and Thermal energy storage involves the capture and storage of thermal energy (either heat or chill) during one time period for use at a later period. Storage of thermal energy in aquifers on a seasonal basis is one promising application of the technology that has been implemented in several foreign countries and is currently undergoing field testing in the U.S. Potential developers of aquifer thermal energy storage projects will face a number of regulatory requirements at the federal, state, and regulatory requirements at the federal, state, and local level of government. These can include meeting: (1) surface land and groundwater use restric-tions, (2) regulations relating to withdrawal of groundwater, and (3) requirements for reinjecting thermally altered groundwaters. Separate permits for groundwater withdrawal and reinjection may be required. The permit process is likely to involve opportunities for public comment and may involve contested proceedings. (Author's abstract) W90-06825

ROLE OF ADVISORY BOARDS IN A WATER MANAGEMENT AGENCY.

Saskatchewan Univ., Saskatoon. Dept. of Agricultural Engineering. J. A. Gillies.

Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1243-1248, December 1989. 1 fig. 1 tab, 4 ref.

criptors: *Administrative agencies, policy, *Water resources management, Advisory boards, Canada, Interagency cooperation, Public participation, Saskatchewan, Water law.

Since Saskatchewan assumed the responsibility for managing the Province's water resources in 1930, managing the Province's water resources in 1930, the importance of the Province's water resources has been recognized by assigning the responsibility for managing the resources to higher levels in the government structure. With such recognition, there tended to be an overlapping of responsibilities that resulted in undefined areas of jurisdiction and duplication of services. Also, there was no opportunity for direct public participation in the management structure. These deficiencies were recognized, and following a series of public hearings a Cabinet Committee on Water Concerns in 1983 concluded that the most appropriate governrecognized, and following a series or public near-ings a Cabinet Committee on Water Concerns in 1983 concluded that the most appropriate govern-ment structure for managing the water resources of Saskatchewan would be a Crown corporation. As a result, in 1984 the Saskatchewan Water Corpora-tion was formed and given the responsibility to manage, administer, develop, control, and protect the water and related land resources in Saskatche-wan. An important aspect of this responsibility was that the corporation should initiate a process of public involvement. Thus, six Regional Watershed Advisory Boards were established. The Advisory Boards provide the Corporation with a linkage to the general public by providing advice, participatboards provide the Corporation with a linkage to the general public by providing advice, participat-ing in policy revision and development, and assist-ing Corporation staff in other related water management activities. (Author's abstract)

AMBIENT WATER QUALITY CRITERIA FOR 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN.

Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards. For primary bibliographic entry see Field 5G. W90-07466

6F. Nonstructural Alternatives

COASTAL ZONE: OCCUPANCE, MANAGE-MENT AND ECONOMIC COMPETITIVENESS. HAECON N.V., Ghent (Belgium).

R. H. Charlier.

Ocean and Shoreline Management OSMAE6, Vol. 12, No. 5/6, p 383-402, 1989. 36 ref.

Descriptors: *Coastal zone management, *Economic aspects, *Legislation, *Planning, Coastal waters, Competing use, Environmental quality, Shores.

The main characteristics of the coastal zone are The main characteristics of the coastal zone are reviewed, especially in relation to the problems it is subject to from the point of view of both natural and human-induced processes. Strategies for adaptation and management are discussed. The different types of activities in coastal areas and the conflicts between them are commented upon; possible lines of action to solve the conflict between development and maintenance of environmental quality are proposed. Planning, in order to adapt human actions to natural processes is considered essential, as well as stricter legislation and control. (Male-PTT) W90.06682

WATER MANAGEMENT AND ECOLOGICAL PERSPECTIVES OF THE UPPER RHINE'S FI CODDELAINS

Institute for Floodplains Ecology, Rastatt (Germany, F.R.).

E. Dister, D. Gomer, P. Obrdlik, P. Petermann, and E. Schne

Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 1, p 1-15, January/February 1990. 6 fig, 2 tab, 47 ref.

Descriptors: *Ecosystems, *Flood control, *Flood plain management, *Flood plains, *Rhine River, Biological communities, Dikes, Europe, History, Hydroelectric power, Rehabilitation, Water resources develop

Field 6-WATER RESOURCES PLANNING

Group 6F-Nonstructural Alternatives

The Upper Rhine floodplains have a diverse geomorphology, hydrology, vegetation, and fauna. They have undergone far-reaching changes over the last 170 yr, particularly in the period 1955-1977, as a result of water engineering measures. The consequences of the various water engineering measures, including flood control measures (dikes), measures, including flood control measures (dikes), navigational improvements, and hydropower development are summarized here with examples. Biotic communities in the Upper Rhine floodplains have been changed in terms of their plant communities, invertebrate fauna, ichthyofauna, and aviatuna. Flood control measures have had several negative effects on the floodplains themselves: (1) flooding occurs too result to result to negrit the development. flooding occurs too rarely to permit the develop-ment of floodwater-tolerant vegetation; (2) the water in polders stagnates; (3) the water depth in polders is higher than it would be under a natural flooding regime; and (4) flood waves are retarded by the flood plain only in the case of catastrophic floods. Deliberate reflooding of formerly inundated areas is recommended wherever possible as a means of restoring 'renaturalizing' the floodplain by restoring quasi-natural dynamics. (Rochester-W90-07331

6G. Ecologic Impact Of Water Development

BRAZIL'S BALBINA DAM: ENVIRONMENT VERSUS THE LEGACY OF THE PHARAOHS IN AMAZONIA.

Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil). Dept. of Ecology. P. M. Fearnside.

Environmental Management EMNGDC, Vol. 13, No. 4, p 401-423, July/August 1989. 5 fig, 99 ref.

Descriptors: *Balbina Dam, *Brazil, *Dam effects, *Environmental effects, *Hydroelectric plants, *Project planning, *Water resources development, Decision making, Electrical power production, Environmental impact statement, Forest water-

The Balbina Dam in Brazil's state of Amazonas The Balbina Dam in Brazil's state of Amazonas floods 2360 sq km of tropical forest to generate an average of only 112.2 mega Watts (MW) of electricity. The flat topography and small size of the drainage basin make output small. Vegetation has been left to decompose in the reservoir, resulting in acidic, anoxic water that will corrode the turbin The shallow reservoir contains 1500 islands and innumerable stagnant bays where the water resi-dence time will be even longer than the average time of over one year. Among Balbina's impacts are loss of potential use of the forest and displacement of about one-third of the surviving members of a Amerindian tribe, the Waimiri-Atroari. The or a Ameringan tribe, the Wammi-Arroar. Ine dam was closed on 1 October 1987 and the first of five generators began operation in February 1989. The example of Balbina points to important ways that the decision-making process could be im-proved in Brazil and in the international funding exercises that have directly and indirectly contribagencies that have directly and indirectly contribagencies that have directly and intiffectly contrib-uted to the project. Environmental impact analyses must be completed prior to decisions on overall project implementation and must be free of influ-ence from project proponents. The current environmental impact assessment system in Brazil, as in many other countries, has an undesirable science many other countries, has an undesirable science, policy, in addition to failing to address the underly-ing causes of environmentally destructive develop-ment processes and inability to halt projects like Balbina. (Author's abstract)

LOCAL GOVERNMENT POLICIES TOWARDS ENVIRONMENTALLY SENSITIVE AREAS IN BRITISH COLUMBIA, CANADA; WASHING-TON AND OREGON, USA.

Washington State Univ., Pullman. Program in Environmental Science and Regional Planning. For primary bibliographic entry see Field 6E.

EFFECTS OF POWER-LINE CONSTRUCTION ON WETLAND VEGETATION IN MASSACHU-

ON WELLAND SECTIS, USA.
Tufts Univ., Medford, MA. Dept. of Biology.
For primary bibliographic entry see Field 4C.

EXPECTED EFFECTS OF THE USE OF THE OOSTERSCHELDE STORM SURGE BARRIER ON THE SURVIVAL OF THE INTERTIDAL FAUNA: PART 1. THE EFFECTS OF PROLONGED EMERSION. Delta Inst. for Hydrobiological Research, Yerseke Okta Inst. for Hydrobiological

(Netherlands).
A. W. Fortuin, H. Hummel, A. Meijboom, and L.

Marine Environmental Research MERSDW, Vol. 27, No. 3/4, p 215-227, 1989. 4 fig, 2 tab, 32 ref.

Descriptors: *Ecosystems, *Emersion, *Environ-mental impact, *Scheldt Estuary, *Survival, *The Netherlands, Anemones, Intertidal areas, Mortali-ty, Polychaetes, Reproductive cycle, Seasonal ty, Polychaetes, Reprod-effect, Storm surge barrier.

In order to assess limits for the use of the Oosters-chelde storm surge barrier (SW Netherlands) within which damage to the environment will be minimal, effects of prolonged emersion from 2 to 8 days on survival of the intertidal fauna were invesdays on survival of the intertidal fauna were inves-tigated in semi-field and laboratory experiments. During most of the year, a period of prolonged emersion of 2 days will only cause mortality in a few species, providing extremely low or high tem-peratures do not occur. Longer periods of emer-sion, however, will cause a high mortality among many species, especially small polychaetes and an-emones, in most seasons, except winter and early emones, in most seasons except winter and early spring. The differences in sensitivity between species may be due to differences in size/volume ratios or possession of a shell, protecting the animal from desiccation. The higher sensitivity in summer may, in some species, coincide with the reproductive cycle. (See also W90-06640) (Author's abstract)

EXPECTED EFFECTS OF THE USE OF THE COSTERSCHELDE STORM SURGE BARRIER ON THE SURVIVAL OF THE INTERTIDAL FAUNA: PART 2. THE EFFECTS OF PRO-TRACTED TIDAL CYCLES.

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands) W. Fortuin, H. Hummel, A. Meijboom, and L.

Marine Environmental Research MERSDW, Vol. 27, No. 3/4, p 229-239, 1989. 1 fig, 6 tab, 8 ref.

Descriptors: *Ecosystems, *Intertidal areas, *Scheldt Estuary, *Survival, *The Netherlands, *Tides, Emersion, Mortality, Storm surge barrier, Temperature effects.

In order to ascertain limits for the use of the Oosterschelde storm surge barrier (SW Netherlands) effects of protracted tidal cycles with low water periods of 18 and 30 hours, instead of the usual 6, on the survival of the intertidal fauna were usual 6, on the survival of the intertidal fauna were investigated in semi-field and laboratory experiments. Protracted low water periods of 18 hours during several weeks did not cause much damage among the intertidal animals, provided extremely high or low temperatures did not occur. Protracted periods of 30 hours (followed by 2 or 3 days of emersion), however, caused a high mortality among the intertidal animals. (See also W90-06639) (Author's abstract) (Author's abstract) W90-06640

ADDITIONS TO THE DIATOMS OF VIRGIN-IA'S INLAND FRESH WATERS: LAKE BAR-CROFT, FAIRFAX COUNTY, VIRGINIA. George Washington Univ., Washington, DC. Dept. of Biological Sciences. For primary bibliographic entry see Field 2H. W90-06653

COASTAL ZONE: OCCUPANCE, MANAGE-MENT AND ECONOMIC COMPETITIVENESS.

HAECON N.V., Ghent (Belgium). For primary bibliographic entry see Field 6F. W90-06686

SMALL HYDROPOWER DEVELOPMENT AND THE ENVIRONMENT: A SURVEY OF STATE AND FEDERAL LAW.

For primary bibliographic entry see Field 6E. W90-06701

LESSONS FROM THE TUCURUI EXPERI-ENCE

Monosowski Associate Consultants, SIC Ltd. Sao Paulo, Brazil. E. Monosowski

International Water Power and Dam Construction IWPCDM, Vol. 42, No. 2, p 29-34, February 1990.

Descriptors: *Brazil, *Dam effects, *Environmental impact, *Tucurui Dam, Amazon region, Dam construction, Economic aspects, Management planning, Political aspects, Regional studies, Tropical regions, Water resources development.

The environmental impacts of the Tucurui dam The environmental impacts of the Tucuru dam (Brazil) have been widely debated and often criti-cized. Tucurui was the first scheme in the Amazon region where environmental impact assessment (EIA) was used as a tool, so experience was limit-ed. Several scientific, managerial, and political shortcomings have been identified in the economic and environmental appraisals for the Tucurui project in relation to the actual occurrences after the project was finished. Based on the experience with EIA at Tucurui (summarized herein), the following basic strategic approaches are recom-mended: (1) clearly stating national and regional environmental/development policies and goals; (2) adjustment of projects to multiple objectives and priorities; (3) comprehensive review of governmental energy strategy in relation to national/regional goals; (4) distribution of some energy production revenue to regional and local communities;
(5) project implementation should contribute to (3) project implementation should contribute to overall regional development; (6) a continuous, interactive, and adaptive planning process should be employed throughout the project cycle; (7) project implementation should be ensured by a strong financial base; (8) decision making should be subject to external review and public participation; (9) basic scientific knowledge should be developed. (9) oasic scientific knowinger should be developed concerning tropical ecosystems, particularly rain forests; (10) Brazilian self-reliance in the environmental studies field should be increased; and (11) a horizontal authority (formal or informal) should be developed to coordinate the interests of different sectors and to liaise with government agencies and other organizations. The Tucurui experience has made a positive contribution to the rapid evolution of environmental management techniques recently adopted by Brazil's electrical sector. (Rochesteradopt PTT) W90-06874

INTEGRATED USE OF NATURAL RE-SOURCES AND GEOENVIRONMENT. Stavebni Geologie, Prague (Czechoslovakia). Hy-

drogeology Dept.

J. Vrba, and B. Moldan.

Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 3, p 159-165, November/ nber 1989. 4 ref.

Descriptors: *Czechoslovakia, *Environmental effects, *Natural resources, *Resources development, *Resources management, *Water resources development, Groundwater use, Soil management.

Natural resources and the geoenvironment have been an interest and need of mankind throughout history. Exploitation of natural resources occurred mear Prague, Czechoslovakia prior to the industrial revolution of the 18th century. Since that time, spectacular technological and economic develop-ment has led to a large increase in the consumption of renewable and nonrenewable resources. The material flow presently connected with man's activities, 30 billion tons every year, is comparable

Ecologic Impact Of Water Development—Group 6G

with the annual flow of matter within the global sedimentary cycle. However, the use of natural resources is not uniformly distributed, and a less than optimal use of the geoenvironment is occur-ring. A modern approach emphasizing the integrat-ed use of natural resources and the geoenviron-ment is desirable. A given region should be treated ment is desirable. A given region should be treated as a single multicomponent space, like a complex web formed by, and held together with, many threads. The integrated approach is not static, but, rather, is a dynamic system which evolves and changes over time. To create such a system, the development of new methods of geological re-search, more effective methods and technologies of natural resources avoigation and the nectection. natural resources exploitation and the protection and restoration of the geoenvironment is required. (Author's abstract) W90-06958

CENOLOGICAL RELATIONS OF MUD VEGE-TATION OF A HYPERTROPHIC LAKE IN TIS-ZAALPAR BASIN.

Jozsef Attila Univ., Szeged (Hungary). Dept. of

For primary bibliographic entry see Field 2H. W90-07110

CHANGES OF SOME PHYSICO-CHEMICAL AND SAPROBIOLOGIC CHARACTERISTICS IN THE LOWER COURSE OF THEISS IN THE

PERIOD 1980-1986. Novi Sad Univ. (Yugoslavia). Inst. of Biology. For primary bibliographic entry see Field 2H. W90-07111

DEVELOPMENTS IN THE COMPOSITION OF BIOCENOSIS IN THE LOWER TISA RIVER (YUGOSLAVIA) CAUSED BY HYDROLOGI-CAL CHANGES.

Novi Sad Univ. (Yugoslavia). Inst. of Biology. For primary bibliographic entry see Field 2H. W90-07114

CHANGES IN THE QUALITY OF WATER IN LASKO STREAM AND THE STORAGE LAKE BUILT ON IT AT EGERSZALOK.

Heves County Service of Public Health and Epidemiology, Eger (Hungary).

For primary bibliographic entry see Field 5C.

COMPREHENSIVE EVALUATION OF THE RESULTS OF THE DAPHNIA TEST CARRIED OUT AT THE TISZA-SECTION AND MAJOR DISTRICT WATERS IN SZOLNOK COUNTY (1977-87).

(1971-81), Szolnok County Service of Public Health and Epi-demiology (Hungary). Water Microbiological Lab. For primary bibliographic entry see Field 5G. W90-07120

ORIENTATION OF ZOOPLANKTON TO THE OXYCLINE IN BIG SODA LAKE, NEVADA. Nevada Univ., Las Vegas. Dept. of Biological

For primary bibliographic entry see Field 2H. W90-07140

COEXISTENCE OF TWO SPECIES OF SUCKER, CATOSTOMUS, IN SAGEHEN CREEK, CALIFORNIA, AND NOTES ON THEIR STATUS IN THE WESTERN LAHON-

TAN BASIN.
California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 2E.
W90-07141

RESPONSE OF NESTING WATERFOWL TO FLOODING IN GREAT SALT LAKE WETLANDS.

Utah State Univ., Logan. Dept. of Fisheries and

A. L. Foote. Great Basin Naturalist GRBNAR, Vol. 49, No. 4,

p 614-617, October 1989, 2 fig. 15 ref.

Descriptors: *Birds, *Saline lakes, *Utah, *Water-fowl, *Wildlife habitats, Anas, Animal populations, Aythya, Ducks, Gadwalls, Mallards, Marshes, Population dynamics, Redheads, Teals, Water birds.

The marshes along the north and east shores of Great Salt Lake have been extremely important breeding grounds for redheads (Aythya americana) and cinnamon teal (Anas cyanoptera). Gadwalls (Anas strepera) and mallards (Anas platrygynchos) were also locally common breeders. Continental were also locating Common breeders. Continential subpopulations such as these operate under a mi-gratory tradition; after maturing, females return to the marsh near the area in which they were raised. During 1983-1986 the Great Salt Lake experienced During 1983-1986 the Great Salt Lake experienced consecutive record-breaking lake level rises, inundating approximately 175,000 hectares of wetlands. The inundation of 1983 displaced approximately 20,000 nesting waterfowl. Ten protected marshes in the Great Basin were surveyed for changes in numbers of breeding pairs of waterfowl during each of four years preceding Great Salt lake flooding and four years following flooding. The hypothesized increase in numbers of breeding birds did not occur, indicating that flood-displaced waterfowl did not move into nearby suitable habitat to fowl did not move into nearby suitable habitat to nest. It is speculated that most nesting ducks moved out of the Great Salt Lake region to find suitable nesting habitat elsewhere. (Mertz-PTT) W90-07142

MOURNING DOVE USE OF MAN-MADE PONDS IN A COLD-DESERT ECOSYSTEM IN

South Dakota State Univ., Brookings. Dept. of Wildlife and Fisheries.
For primary bibliographic entry see Field 2H.
W90-07143

ARAL SEA AND THE ECOLOGICAL SITUATION IN CENTRAL ASIA AND KAZAKHSTAN,

A. A. Tursunov. Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 319-325, 1990. 2 fig, 2 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 15-19, June, 1989.

Descriptors: *Aral Sea, *Dam effects, *Irrigation effects, *Saline lakes, *Soviet Union, *Water quality, Ecological effects, Environmental effects, Health effects, Lake fisheries.

The Aral Sea, in Kazakhastan, USSR, is the second largest endorheic water body. It fluctuated within it natural limits up to 1965, with an average long-term elevation level of 53 m. The sea had a water surface area of 64,000 sq km and water volume of 1020 cu km with an average depth of volume of 1020 cu km with an average depth of the water did not exceed 7-9 g/L and valuable commercial fish species were found in it. Starting in 1965, after the mass development of cotton growing in the Central Asian republics and construction of large reservoirs on the Syr Darya and Amy Darya givers the layed of the see became to Amu Darya rivers, the level of the sea began to drop intensely from an elevation of 51.7 m in 1970, reaching an elevation of about 40 m in 1987. Minreaching an elevation of about 40 m in 1987. Min-eralization of the water accordingly reached 22 g/ L and by 1983 it completely lost any fishery sig-nificance. At present, the sea level is close to 40 m, its area is 40,000 square km, and volume in 400 cubic km. Up to 75 million tons of sand and dust can rise annually into the atmosphere from the surface of the desert surrounding the sea. The salts being removed from the bottom of the Aral for the greater part (60-80%) represent sulfates. Thenat-dite forms a light white proyeder (nuff) during the greater part (60-80%) represent suitates. Inenar-dite forms a light white powder (puff) during the summer when soil temperatures reach 60C. Enter-ing human and animal respiratory organs, thenar-dite is instantaneously enveloped by water mole-cules, forming microscopic ulcers and gradually covering the internal cavities with a solid salt-dust crust, which is the cause of such diseases in the Aral region as brucellosis, tuberculosis, bronchial arathma, and other respiratory diseases. Intensified melting of the marginal glacier of the Zalliskii Alatau has been noted since 1970, which is a reliable indicator of a change in the region's cli-

mate. In the immediate years, it will be possible to stably deliver about 30 cubic km of water to the Aral Sea. In the future, the annual releases to the Aral Sea can be increased to 40-50 cubic km. It is necessary to remove the severely salinized and low-productive lands from cotton and rice growing along rivers feeding the Aral. (Mertz-PTT) W90-07166

PROBLEMS OF THE ARAL SEA AND RECION

A. K. Kivatkin. Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 325-328, 1990. 1 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 20-22, June. 1989

Descriptors: *Aral Sea, *Irrigation water, *Soviet Union, *Water distribution, *Water pollution, *Water quality, *Water quality, management, *Water reuse, Armu Darya River, Drinking water, Irrigation practices, Saline water, Syr Darya River, Water conservation, Water resources development, Water resources management, Water scarcity, Water supply development city. Water supply development

The undesirable ecological consequences in the Aral region of the USSR is the natural result of Aral region of the USSR is the natural result of rapid economic development of the region caused by rapid growth of the size of the population. Before 1917 about 7 million people lived in the Central Asian region, at present about 37 million, by the year 2000 there will be 50 million, and in the first quarter of the 21st century there will be up to 70 million people. By 1987 irrigated lands reached 7.3 million hectares versus 3.5 million hectares before 1917. With complete exhaustion of local water resources, even with their conservation irrigated land can be expanded only to 8. hectares before 1917. With complete exhaustion of local water resources, even with their conservation, irrigated land can be expanded only to 8.3 million hectares. Consequently, during the period under consideration land areas increased by 2.4 times and the population size by 5 times. With such an acute situation, the water-management balance is reckoned only because of the multiple use of return waters from the irrigated lands and wastewaters of industrial enterprises and municipal services. Multiple recycling of water by no means promotes an improvement of its quality in rivers. The quality of the river waters in the lower course of the Amu Darya and Syr Darya deteriorated catastrophically; they became unfit as the drinking water supply of the population. The ecosystems in the Aral region are degrading. Local species of animals and plants are usappearing, soil fertility, the efficiency of the economy, and consequently, the standard of living of the inhabitants in the Aral region are decreasing. Serious shortcomings are occurring in the use of water resources in irrigated agriculture. Means are being directed at the largeagriculture. Means are being directed at the large-scale reconstruction of lands, reconstruction of the collector-drain network, and construction of un-derground water pipelines, as well as several large main water-diversion channels with their outlet in the Aral sea. Studies have determined that the fulfillment of all planned works will enable the permit the regioin to live on its own water re-sources up to 2005-2010. Further development of the Central Asian republics and Kazakhstan will be extremely complicated without drawing additional water here. (Mertz-PTT) W99-07165 collector-drain network, and construction of un-W90-07167

INFLUENCE OF CONSTRUCTION ON HY-DROGEOLOGICAL AND ENVIRONMENTAL CONDITIONS IN THE KARST REGION, EAST-ERN HERZEGOVINA, YUGOSLAVIA.

Karst Water Research Inst., Trebinje (Yugoslavia). P. Milanovic.

Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 1, p 5-11, January/February 1990. 2 fig, 4 ref.

Descriptors: *Aquifers, *Catchment areas, *Dam effects, *Geohydrology, *Groundwater, *Karst hydrology, *Springs, *Water resources development, *Yugoslavia, Dam construction, Poljes, Reservoir construction, Seismic properties, Tunnel construction, Water pollution.

Field 6—WATER RESOURCES PLANNING

Group 6G-Ecologic Impact Of Water Development

The region of eastern Herzegovina and Dubrovnik coastal belt is one of the hydrogeologically and hydrologically most interesting regions of Yugohydrologically most interesting regions of Yugo-slavia karst. The main water course in the region is the Trebisnjica river, the largest sinking river in Europe. All the poljes in the catchment area are temporarily flooded, hydrologically separated, and closed karst entities. Enormous quantities of avail-able water are not evenly distributed either in time or in space. The Trebisnjica Hydrosystem project uses the basic concept of total water regime orga-nization and its multipurpose utilization. With the construction of seven dans, six artificial reservoirs. nization and its multipurpose utilization. With the construction of seven dams, six artificial reservoirs, six tunnels (total length 57 km), and four canals (total length 74 km), the natural regime of surface and underground waters has been completely changed. As a consequence of water regime disturbance, many changes that have been observed in the catchment area: changes in the karst aquifers; local changes of climate conditions; eolic erosion effect; influence on the karst underground and litteral belt: influence on the servine yield: and littoral belt; influence on the spring yield; influence on adjacent catchment area include: polinfluence of adjacent caterinent area include: por-lution of karst aquifers and influence of storage reservoirs on seismicity. (Author's abstract) W90-07187

LOW-HEAD HYDROPOWER IMPACTS ON STREAM DISSOLVED OXYGEN. Minnesota Univ., Minneapolis. St. Anthony Falls

Minnesota Univ., Minneapolis. St. Antiony Palis Hydraulic Lab. J. R. Thene, H. G. Stefan, and E. I. Daniil. Water Resources Bulletin WARBAQ, Vol. 25, No. 6, p 1189-1198, December 1989. 6 fig. 1 tab, 18 ref.

Descriptors: *Dam effects, *Dissolved oxygen, *Hydroelectric plants, *Low-head hydroelectric plants, *Oxygen transfer, *Water quality, Aeration, Dams, Mathematical models.

A method to evaluate the effect of hydropower A method to evaluate the effect of hydropower development on downstream dissolved oxygen (DO) is presented for a low head dam. Water, previously aerated during release over spillways and under gates, is diverted through the hydropower facility without further aeration. The oxygen transfer that occurs as a result of air entitled of the control of the trainment at the various release points of a dam is measured. Oxygen transfer efficiencies are calculated and incorporated into an oxygen transfer model to predict average release DO concentrations. This model is used to systematically detertions. This model is used to systematically deter-mine the effect of hydropower operation on down-stream DO. Operational alternatives are investigat-ed and a simple operational guide is developed to mitigate the effects of hydropower operation. Combinations of reduced generation and optimal releases from the dam allow the hydropower facili-ty to operate within DO standards. (Author's ab-

HOLISTIC APPROACH TO ECOSYSTEM HEALTH ASSESSMENT USING FISH POPULATION CHARACTERISTICS. Guelph Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field 5A.

IMPACT OF CHANNELIZATION ON THE HY-DROLOGY OF THE UPPER RIVER MAIN, COUNTY ANTRIM, NORTHERN IRELAND: A

LONG-TERM CASE STUDY. Ulster Univ. at Jordanstown, Newtownabbey (Northern Ireland). Dept. of Computing Science. For primary bibliographic entry see Field 4A. W90-07332

RIVER ENGINEERING IN NATIONAL PARKS: THE CASE OF THE RIVER WHARFE, U.K. University of East Anglia, Norwich (England). School of Environmental Sciences. For primary bibliographic entry see Field 4A. W90-07333

CHANGES IN PLANKTON COMMUNITIES IN REGULATED REACHES OF THE LOWER RHINE RIVER.

Rijksinstituut voor de Volksgezondheid en Milieuygiene, Bilthoven (Netherlands). . D. de Ruyter van Steveninck, W. Admiraal, and

B. Van Zanten. Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 1, p 67-75, January/February 1990. 5 fig, 1 tab, 30 ref.

Descriptors: *Plankton, *Rhine River Delta, *Succession, *The Netherlands, Bacteria, Chlorophyll a, Crustaceans, Deltas, Diatoms, Estuaries, Mollusks, Phytoplankton, Rotifers, Zooplankton.

The Dutch section of the Lower Rhine is highly The Dutch section of the Lower Rhine is highly modified by regulating measures, such as the construction of weirs and the closure of estuarine river mouths, which seriously affect sedimentation of suspended material. During the 1987 the fate of the plankton communities in Rhine in The Netherlands was studied. Water samples were taken fortnightly at the German-Dutch border and in the main branch of the Rhine, just before it debouches into the North Sea. Dry weights of suspended matter, bacterial numbers, phytoplankton biomass (as chlorophyll a), and zooplankton composition and biovolume were determined. On two occasions phytoplankton composition and biovolume also were plankton composition and biovolume also were determined. Suspended matter and bacteria disapdetermined. Suspended matter and bacteria disappeared during transport in the Rhine Delta. Phytoplankton biomass (primarily diatoms) showed typical spring and summer peaks and also decreased in the investigated river reach. In contrast, zooplankton developed a higher biomass due to an increase in the numbers of rotifers, crustaceans, and molluscan larvae, whereas arcellas and ciliates decreased in numbers. It is concluded that the Rhine after in numbers. It is concluded that the Rhine, after flowing more than 800 km, meets in its delta the proper conditions for development of a true plank-ton community; settling and trophic interactions become of increasing importance in determining the structure of plankton communities. (Author's abstract) W90-07336

ENGINEERING OPERATIONS AND INVERTEBRATES: LINKING HYDROLOGY WITH

ECOLOGY.

Leicester Univ. (England).

C. D. Smith, D. M. Harper, and P. J. Barham.

Regulated Rivers Research & Management

RRMEP, Vol. 5, No. 1, p 89-96, January/February 1990. 5 fig, 4 tab, 30 ref.

Descriptors: *Aquatic habitats, *Benthic fauna, *England, *Welland River, Design criteria, Management planning, Pools, Riffles, River training.

The River Welland, East Midlands, England, has The River Welland, East Midlands, England, has been regulated in the past for land drainage. Benthic invertebrate family richness and total biomass were measured in riffles, pools, and runs of the River Welland and then related to the frequency of these physical parameters. Changes occurring as a result of (1) loss of channel length through meander cutoffs and (2) alteration of substrate characteristics through dredging and lowering of the river bed were quantified. Riffles comprised 20-30% of the channel in reaches not altered exclusively we engineering elsewhere dredging has prised 20-30% of the channel in reaches not altered seriously by engineering; elsewhere dredging has reduced or eliminated riffles and pools, leaving uniform sandy runs as the dominant channel feature. Riffles, pools, and runs all contribute to overall ecological value, but the riffle and pool biotopes supported higher macroinvertebrate biomass and family richness. Proposals for river management that address the ecological needs of invertebrate communities can be expressed as unperical recommunities. that address the ecological needs of invertebrate communities can be expressed as numerical recommendations for maintaining or enhancing the key physical features of a river. Consequently, conservation recommendations can be simplified and considered in the same forms as the engineering requirements of land drainage. (Author's abstract) W90-07338

STEEL CREEK WATER QUALITY: L LAKE/ STEEL CREEK BIOLOGICAL MONITORING PROGRAM, NOVEMBER 1985-DECEMBER

Environmental and Chemical Sciences, Inc., Aiken, SC. For primary bibliographic entry see Field 5B.

W90-07470

HISTORICAL ARCHAEOLOGY OF DAM CON-STRUCTION CAMPS IN CENTRAL ARIZONA. VOLUME 3: LABORATORY METHODS AND DATABASE COMPUTERIZATION.

Bureau of Reclamation, Phoenix, AZ.

D. A. Hull-Walski, J. E. Ayres, L. J. Franklin, and P. Patterson.

F. Patierson.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB90-193046.
Price codes: A12 in paper copy, A02 in microfiche.
Report No. DI-BR-APO-CCRS 89-13, December 1989. 254p, 2 fig, 5 tab, 104 ref, 7 append

Descriptors: *Archaeology, *Arizona, *Dam construction, *Databases, *Laboratory methods, *Water resources development, Computers, Data storage and retrieval, History, Social aspects.

In June 1986, the Bureau of Reclamation awarded a contract for historical archaeological studies as part of the mitigation program for the Regulatory Storage Division (Plan 6) of the Central Arizona Project. This study focused on reconstructing the social history of the workers and their families social history of the workers and their families who lived in several temporary dam construction camps dating from the 1890s to the 1940s. This is the third (of three) volume of the final technical report. This volume summarizes the general characteristics of the artifact assemblage and describes laboratory processing and analytical procedures. It also describes the strategy developed for building a computerized database. The code book for computerized database. The code book for computerizing the artifactual information is presented along with directories of the various types of marker's marks, glass finishes, methods of opening cans, and animal skeletal parts encountered in the collection. (Author's abstract)

HORSE MESA DAM, MARICOPA COUNTY, ARIZONA: PHOTOGRAPHS, WRITTEN HIS-TORICAL AND DESCRIPTIVE DATA, RE-DUCED COPIES OF DRAWINGS.

Salt River Project, Phoenix, AZ.

D. M. Introcaso

Report No. HAER AZ-15, 1989. 73p. Report pre-pared for U.S. National Park Service, San Francis-

Descriptors: *History, *Horse Mesa Dam, *Water resources development, Arizona, Salt River, Social

This report contains a photographic record and drawings of Horse Mesa Dam, built between 1925 and 1937 on the Salt River in Central Arizona. The and 1937 on the salt kiver in Central Artzona. In narrative history of the dam is contained in another report (HAER AZ-14), which documents Mormon Flat Dam downstream of Horseshoe Dam. (See also W90-07497) (Author's abstract) W90-07496

MORMON FLAT DAM, MARICOPA COUNTY, ARIZONA: PHOTOGRAPHS, WRITTEN HISTORICAL AND DESCRIPTIVE DATA, REDUCED COPIES OF DRAWINGS.

Salt River Project, Phoenix, AZ.

D. M. Introcaso.

Report No. HAER AZ-14, 1989. 123p. Report prepared for U.S. National Park Service, San Fransico, CA.

Descriptors: *History, *Mormon Flat Dam, *Water resources development, Arizona, Economic aspects, Salt River, Social aspects.

This report provides a narrative history of the political and economic factors leading to the construction of Mormon Flat Dam, constructed between 1923 and 1926 on the Salt River, Arizona. The report also contains photographs and drawings of the construction of the dam, and how it looks today (1989). (See also W90-07496) (Author's abstract) abstract)

RESOURCES DATA—Field 7

Data Acquisition—Group 7B

DREDGING: BIOLOGICAL EFFECTS (JAN 79 -

National Technical Information Service, Spring-

Available from the National Technical Information Service, Springfield, VA. 22161, as PB89-868368. Price codes: NOI in paper copy, NOI in microfiche. Report NZ 6120, August 1989. 136p.

Descriptors: *Bibliographies, *Biological studies, *Dredging, *Waste disposal, *Water pollution effects, Aquatic environment, Bioaccumulation, Chronic toxicity, Degradation, Ocean dumping.

The bibliography contains 315 citations, 44 of which are new entries to the previous edition, concerning habitat degradation and development due to dredging operations and disposal. Topics include environmental impact studies, long-term effects, aquatic ecosystem response studies, and bioaccumulation of materials contained in dredge spoils. Ocean disposal operations, and studies per-formed in specific areas are also discussed. (Author's abstract)

7. RESOURCES DATA

7A. Network Design

FORMALISM FOR COMPARING RAIN ESTI-MATION DESIGNS.

Texas A and M Univ., College Station. Coll. of For primary bibliographic entry see Field 7C.

NETWORK DESIGN FOR WATER SUPPLY

FORECASTING IN THE WEST. Hydex, Inc., Vienna, V. E. L. Peck, and J. C. Schaake. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 87-99, February 1990. 10 fig, 14 ref.

Descriptors: *Data acquisition, *Forecasting, *Model studies, *Network design, *Potential water supply, *Water resources data, *Water supply, DATANET, Rainfall, Runoff, Seasonal variation.

The objective is to develop techniques to evaluate how changes in basic data networks can improve accuracy of water supply forecasts for mountainous areas. The approach used was to first quantify how additional data would improve knowledge of winter mentions and accord to estimate to winter precipitation, and second to estimate how this knowledge translates, quantitatively, into imthis knowledge translates, quantitatively, into improvement in forecast accuracy. A software system called DATANET was developed to analyze each specific gage network alternative. This system sets up a fine mesh of grid points over the basin. The long-term winter mean precipitation at each grid point is estimated using a simple atmospheric model of the orographic precipitation process. The mean runoff at each grid point is computed from the long-term mean precipitation estimate. The basic runoff model is calibrated to produce the observed long-term runoff. The error analysis is accomplished by comparing the error in forecasts accomplished by comparing the error in forecasts based on the best possible estimate of precipitation using all available data with the error in the foreusing all available data with the error in the fore-casts based on the best possible estimate of winter precipitation using only the gaged data. Different data network configurations of gage sites can be compared in terms of forecast errors. (Author's W90-06826

SURFACE GEOELECTRICS FOR THE STUDY OF GROUNDWATER POLLUTION: SURVEY DESIGN

Geofyzika N.E., Geologicka, Barrandov (Czechoslovakia). O. Mazac, I. Landa, and W. E. Kelly.

O. Mazasa, i. Landa, and W. E. Keliy. Journal of Hydrology JHYDA7, Vol. 111, No. 1-4, p 163-176, November 1989, 9 fig. 3 tab, 17 ref. USGS Awards 14-08-0001-G1503 and 14-08-000FG1133.

Descriptors: *Electrical studies, *Geophysical exploration, *Geophysics, *Groundwater pollution, *Network design, *USSR, Czechoslovakia, Geoelectrics, Labe River, Oil pollution, Pollutant identification, Rhode Island, River Volga.

The basic principles and possibilities for applying geoelectric methods to groundwater protection and pollution detection problems were described in an earlier paper. Several case histories are presented to illustrate considerations in the design of field measurements: choice of primary and supplemental methods, minimum number of parametric measurements, and optimum measurement network. Choice of primary and supplemental methods is discussed in relation to data from four sites in the Soviet Union; determining the minimum number of parametric measurements is discussed in relation to data from the River Volga (Soviet Union), and optimum density of the measurement network is considered in relation to data from the Chuj Valley (Soviet Union). Two additional case histories are (Soviet Union). Two additional case histories are presented to illustrate problems encountered in applying electrical methods to groundwater pollution due to immiscible pollution on the Labe River, Czechoslovakia; liquid wastes from a uranium-bearing cold scrap recovery plant at Wood River Junction, Rhode Island. The case histories discussed here confirm that pollution problems are varied and that each must be handled individually. They also indicate the important role of geophysical methods in solving pollution problems. (Rochester-PTT) W90-06892

GROUND-WATER MONITORING COMPLI-ANCE PROJECTS FOR HANFORD SITE FA-CILITIES: PROGRESS REPORT FOR THE PERIOD JANUARY 1 TO MARCH 31, 1988. VOLUME 3: APPENDIX A (CONTD). Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 5A. W90-07476

GROUND-WATER MONITORING COMPLIANCE PROJECTS FOR HANFORD SITE FACILITIES: PROGRESS REPORT FOR THE PERIOD JANUARY 1 TO MARCH 31, 1988. VOLUME 2: APPENDIX A. Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 5A. W90-07477

7B. Data Acquisition

MEASUREMENT OF BACTERIAL SULFATE REDUCTION IN SEDIMENTS: EVALUATION OF A SINGLE-STEP CHROMIUM REDUCTION METHOD.

us Univ. (Denmark). Inst. of Ecology and Genetics. For primary bibliographic entry see Field 2K. W90-06555

QUANTITATIVE ESTIMATION OF DIATOM ALGAE USING THE SCANNING AND TRANS-MISSION ELECTRON MICROSCOPES. Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.

Diatom Research, Vol. 4, No. 2, p 249-254, 1989. 6 tab, 23 ref.

Descriptors: *Algae, *Diatoms, *Electron microscopy, *Microscopic analysis, *Microscopy, *Phytoplankton, *Scanning electron microscopy, Comparison studies, Counting techniques, Estimating, Quantitative analysis, USSR.

In quantitative studies of phytoplankton a method in quantitative studies of phytoplankton is mention of counting the algal cells under the light micro-scope using counting chambers is widely used. For identification of the diatoms, workers also prepare permanent slides. The main disadvantage of this method lies in the nature of light microscopes: the wavelength of the light limits resolution and hence also the useful magnification, which makes it either difficult or impossible to identify algae 2-10 mi-

crometers in size. Electron microscopy has been widely used in diatom taxonomy during the last decade. The advantages of the transmission and scanning electron microscopes in comparison with ight microscopy, in relation to resolution, magnifi-cation range and focussing depth, are well know. A method is proposed for the quantitative assess-ment of phytoplankton using electron microscopy. Algae from Lake Siverskoe, U.S.S.R. were pre-Algae from Lake Siverskoe, U.S.S.K. were pre-pared for electron microscopy using one of the usual cleaning methods. A Czech 300 mesh grid with window dimensions of 65 x 65 micrometers and total transparency 52% was used. The sup-porting film was nitrocellulous extengthened by carbon. The prepared sample was mixed thoroughly and 1 microliter of suspension transferred to the center of a grid. After drying, the subsamples were ready without further treatment for examination ready without further treatment for examination under transmission electron microscopes. Coating with carbon followed by silver or gold was re-quired for scanning electron microscopes. The method has been tested on phytoplankton samples containing diatom populations from thousands to millions of cells per liter. The results of diatom minions of ceils per liter. The results of diatom counts using electron microscopy appear to be quite comparable with data obtained using the light microscope. This method may be used for studies of the nanoplankton fraction (Bacillariophyta) of the phytoplankton. (Mertz-PTT) W90-06578

INFLUENCE OF DIFFERENT LITTER BAG DESIGNS ON THE BREAKDOWN OF LEAF MATERIAL IN A SMALL MOUNTAIN

Cape Town Univ. (South Africa). Dept. of Water Resources and Public Health Engineering. B. A. Stewart, and B. R. Davies. Hydrobiologia HYDRB8, Vol. 183, No. 2, p 173-177, October 9, 1989. 1 fig, 1 tab, 24 ref.

Descriptors: *Biodegradation, *Data acquisition, *Leaves, *Limnology, *Streams, Cunonia, Decomposition, Ilex, South Africa.

Leaf breakdown of two riparian tree species, Cunonia capensis L. and Ilex mitis (L.) was investigated in vitro at Window Stream, Table Mountain, South Africa, using three different designs of litter bag. Breakdown of Cunonia and Ilex in coarsemesh (5mm) litter bags was very rapid (14.79) day for Cunonia and 13.93%/day for Ilex) and was simiferantly greater than the loss of leaf material of significantly greater than the loss of leaf material of 1%/day for both species from fine-mesh bags (180 micrometer). Differences recorded between fine-mesh and composite-mesh bags (180 micrometer mesh and composite-mesh bags (180 micrometer mesh with 5 mm mesh top) represented macro-invertebrate ingestion, and at 28 days amounted to 67.57% material loss in Cunonia and 62.58% in Ilex. The losses due to microbial activity and leaching, 31.28% in Cunonia and 29.17% in Ilex were not significantly different. Weight loss of Cunonia in coarse-mesh bags (14.79% loss/day) and in composite-mesh bags (13.93% loss/day) did not differ, but this was not the case for Ilex, where a significantly higher rate of loss in coarse-mesh bags (13.93% loss/day) was observed. This difference was used to quantify fragmentation losses. It was concluded that future leaf breakdown experiments in mountain streams must take cognizance of differential fragmentation losses before inferences can be made as to both invertebrate feeding prefercan be made as to both invertebrate feeding preferences and biological decomposition of leaves. (Author's abstract) W90-06590

SEQUENTIAL DECISION PLANS, BENTHIC MACROINVERTEBRATES, AND BIOLOGICAL MONITORING PROGRAMS.

California Univ., Berkeley. Dept. of Entomologi-

For primary bibliographic entry see Field 5A.

SEMIQUANTITATIVE X-RAY DIFFRACTION METHOD TO DETERMINE MINERAL COMPOSITION IN STREAM SEDIMENTS WITH SIMILAR MINERALOGY.

Field 7—RESOURCES DATA

Group 7B-Data Acquisition

Geological Survey, Reston, VA. D. M. Webster. Environmental Technology Letters ETLEDB, Vol. 10, No. 9, p 833-844, September 1989. 2 fig, 4 tab, 5 ref.

Descriptors: *Data interpretation, *Mineralogy, *Minerals, *Sedimentology, *X-ray diffraction, Chemical analysis, Clays, Feldspar, Geochemistry,

Quartz.

A semiquantitative X-ray diffraction procedure has been developed that can be used to acquire reproducible mineralogic data from geographically unrelated stream-sediment samples having similar mineralogy. Weight percentages for quartz, total-feldspar, and total-clay can be determined by direct comparison of intensities with standard mineral mixtures of known weight percent. Many problems arise when performing this type of semi-quantitative analysis. Determination of bulk mineralogy can be difficult when X-ray peaks are genrated in unknown samples containing a wide range of minerals. Principle peak intensities are affected by differences in crystallinity. Unreliable quantification may result from differences between samples and standards. Variation in clay mineralogy of samples to be analyzed makes the choice of clay standards difficult. Once standards are selected, sample-mounting techniques may produce orientaction artifacts that influence results. Chemical techniques for carbonates and other soluble phases can be used to reduce the number of mineral components, as well as provide multiple analyses for comparing results between natural and freeted be used to reduce the number of mineral compo-nents, as well as provide multiple analyses for comparing results between natural and treated samples. If the number of mineral components is too large, a quantification scheme must be tailored to each individual sample. The accuracy of mineral composition generally fell within the desired 10-percent limit in the 17 unrelated stream-sediment percent limit in the 17 unrelated stream-sediment samples that were analyzed, with the exception of those sediment samples having a relative propor-tion of albite and K-feldspar that deviates consider-ably from a 1:1 mixture. Fortunately, the bulk mineralogy was relatively homogeneous, with the exception of trace amounts of pyrite, hornblende, and appreciable amounts of halite and carbonate in samples. Even under these conditions, quantification curves required about 250 X-ray sca and the calculation of approximately quartz:other-mineral ratios. (Brunone-PTT) W90-06625

STEADY-STATE ANALYSIS OF THE 'MICRO-STEADY-STATE ANALYSIS OF THE 'MICRO-BIAL LOOP' IN STRATIFIED SYSTEMS.

Marine Biological Association of the United King-dom, Plymouth (England).

For primary bibliographic entry see Field 2L.

W90-06631

POLARIZATION RADAR ESTIMATES OF RAINDROP SIZE SPECTRA AND RAINFALL

University of Manchester Inst. of Science and Technology (England). Dept. of Pure and Applied For primary bibliographic entry see Field 2B. W90-06665

COMPARISON OF SEVERAL RADIOMETRIC METHODS OF DEDUCING PATH-INTEGRAT-ED CLOUD LIQUID WATER.
McGill Univ., Montreal (Quebec). Dept. of Mete-

For primary bibliographic entry see Field 2B. W90-06667

FIELD AND LABORATORY COMPARISONS OF TWO CLOUD CONDENSATION NUCLEI COUNTERS.

Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Atmospheric Physics.
For primary bibliographic entry see Field 2B.
W90-06668

REMOTE SENSING OF CLOUDS AND FOG WITH A 1.4-MM RADAR.

Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering. For primary bibliographic entry see Field 2B. W90-06669

NEW TRIGGER MECHANISM FOR SEDI-MENT SAMPLERS.

Queen's Univ., Kingston (Ontario). Dept. of Geography. J. R. Glew.

Journal of Paleolimnology, Vol. 2, No. 4, p 241-243, 1989. 4 fig, 1 ref.

Descriptors: *Bottom sampling, *Samplers, *Sediment sampler, *Sedimentology, *Sediments, Core drilling, Sampling, Water currents, Wind.

Many messenger-triggered devices used for bottom sampling are unreliable or completely inoperative when the attached line is not maintained in a nearvertical position. This occurs when wind and surface currents make station keeping over the sample point difficult which often results in poor sample recovery. A mechanism is described which enables recovery. A mechanism is described whinch enables equipment on the bottom to be triggered reliably without precise station keeping, and has been in-corporated into a number of gravity corers. This mechanism consists of a sliding sleeve mounted coaxially with the operating line which transmits the motion to the release mechanism. The key element in this design is the sleeve that is free to slide on its muniting collar. The operating line passes through this assembly. In this configuration the line angle, and hence the striking angle of the messenger, is not critical because the motion transferred by the not critical because the motion transferred by the sleeve is uniformly aligned with respect to the release mechanism. The free operation of the sleeve is improved by reducing the sleeve/collar contact surface and by ensuring a free flow of water around and through the assembly. The entire assembly, sleeve, collar, and release mechanism, is compact and suitable for adaptation for other types of lightweight instruments. (Male-PTT) W90-06670

LOW-COST, PORTABLE FLOW CYTOMETER SPECIFICALLY DESIGNED FOR PHYTO-PLANKTON ANALYSIS. University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics.

A. Cunningham.

Journal of Plankton Research JPLRD9, Vol. 12, No. 1, p 149-160, January 1990. 9 fig, 29 ref.

Descriptors: *Algae, *Biological samples, *Cytometers, *Instrumentation, *Measuring instruments, *Phytoplankton, Cores, Lasers, Microorganisms, Performance evaluation

This paper describes the construction and testing of a flow cytometer illuminated by a low-power (40 mW), air-cooled argon laser and incorporating a novel flow cell with a wide (0.3 mm) nozzle for hydrodynamic focusing. The resolution of the instrument is comparable to that of commercial equipment operating at much higher laser powers, and it is sensitive enough to detect autoflorescence from single picoplankton cells. By using recent innovations in laser technology and electronics, the design allows a research-quality flow cytometer to be constructed at relatively low cost (approximate-plain). The ly 15,000 English pounds at current prices). The instrument does not require cooling water, threeinstrument does not require cooling water, three-phase power or compressed gas supplies, and is easily portable from one operating site to another. The large focusing nozzle is very resistant to clog-ging by detritus, cell clumps or filaments, but is still capable of producing cores down to 5 microm-eter dismeter. These characteristics are particular-ly suitable for the analysis of microalgal cultures and phytoplankton samples. The discriminatory power of the instrument has been tested using a range of marine and freshwater algae. (Author's abstract) W90-06676

APPLICATION OF REMOTE SENSING TO ESTIMATE LAND COVER FOR URBAN DRAIN-AGE CATCHMENT MODELLING.
J. Finch, A. Reid, and G. Roberts.

Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 3, No. 6, p 558-563, De-cember 1989. 3 fig, 2 tab, 13 ref.

Descriptors: *Aerial photography, *Catchment areas, *Mapping, *Remote sensing, *Surface runoff, *Urban drainage, *Urban hydrology, Computer programs, Model studies, Satellite technolo-

Inis paper compares the estimates of percentage land cover derived from airborne thematic mapper data with those from a traditional survey method. The latter include existing Ordnance Survey maps and an on-the-ground survey supplemented by aerial photographs. The thematic mapper data are segmented using two methods: thresholding and classification. Nine catchments are surveyed using the three methods. The results show that the estimated pervious area, derived by thresholding and classification methods, agrees with that obtained by the traditional method with a mean error of 2% and 8%, respectively. These errors are acceptable for design work using the Wallingford stormsewage package (WASSP) model. The use of airborne thematic mapper imagery is cost-effective, scwage package (WASSF) model. The use of anti-borne thematic mapper imagery is cost-effective, provided that it is acquired as part of an organized mapping program. Satellite data provide an accept-able means of estimating percentages of pervious area for strategic planning. (Sand-PTT) W90-06714

RADIATIVE TRANSFER TO SPACE THROUGH A PRECIPITATING CLOUD AT MULTIPLE MICROWAVE FREQUENCIES. PART III, INFLUENCE OF LARGE ICE PARTI-

Florida State Univ., Tallahassee. Dept. of Meteorology. E. A. Smith, and A. Mugnai.

Journal of the Meteorological Society of Japan JMSJAU, Vol. 67, No. 5, p 739-755, October 1989. 10 fig. 2 tab, 20 ref. NASA Grant NAGW-991, NATO Grants Program for Collaboration in Re-search (0217/87), DOE Contract DE-FC 85ER250000

Descriptors: *Cloud liquid water, *Data acquisi-tion, *Meteorology, *Microwaves, *Radiation, *Radiometry, *Remote sensing, Cloud physics, Data interpretation, Ice, Precipitation, Simulation

Using a vertically and angularly detailed, plane-parallel microwave radiative transfer model, a series of numerical experiments was conducted in conjunction with a cloud model simulation to inconjunction with a croot model simulation to microphysical structure on the transfer to space of passive microwave radiation at several frequencies across the EHF-SHF spectrum. The impact of large ice particles on passive brightness tempera-tures over an evolving model rain cloud were examined at 10 frequencies. Three cloud model designs were considered for both hard ice and low density ice freezing modes. The results emphasize designs were considered for both hard ice and low density ice freezing modes. The results emphasize how the range of frequencies between 10.7 and 231 GHz differentially respond to the various ice models and freezing modes. Frequency-dependent, vertically distributed generalized emission/scattering weighting functions, introduced to vertically resolve the contributions by individual cloud and precipitation layers to the brightness temperatures, can be used to identify the specific layers responsible for regulating the magnitude of top-of-atmosphere brightness temperatures. The weighting function is also coupled to a fractional contribution by scattering function which will exhibit the relative magnitude of the scattering source within the generalized weighting function itself. This enables a thorough understanding of how brightness temperatures are modulated by hydrometeors in individual layers. Additional results are the identification of the importance of incorporating a mixed layer at intermediate and higher frequencies (37 GHz and higher), and quantifying the influence of freezing mode at 85 GHz. The vertical scale of the cloud column, for a fixed equivalent liquid water path, is a major determining factor in generating prightness temperatures consistent with actual obpath, is a major determining factor in generating brightness temperatures consistent with actual ob-servations. This result is based on a case study of a

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Data Acquisition—Group 7B

severe thunderstorm monitored with a 2-channel airborne microwave radiometer during the 1986 COHMEX experiment in northern Alaska. (Author's abstract) W90-06724

CONTEMPORARY TELEMETERING METH-ODS FOR WATER WORKS FACILITIES. Consulting Engineer, Inc., Westwood, MA.
R. H. Babcock.

Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 4, p 221-233, December 1989. 5 fig.

Descriptors: *Remote control, *Telemetry, *Water treatment facilities, Automation, Electrical transmission, Radio waves, Remote ser

The available forms of telemetry for application to water utilities have multiplied since the earliest systems were installed. The type of telemetry most water works personnel are familiar with is known as pulse duration telemetry. This type of telemetry has two serious limitations: (1) the circuit between the transmitter and receiver is usually powered by DC; (2) since conversion from measurement to telemeter signal is slow, i.e. 12 seconds minimum, it can only be effectively used where measurement change is slow. This imposes severe limitations on its use in contemporary water works control sys-tems. With the advent of so-called frequency transtems. With the advent of so-called frequency transmitters, the transmitter transmitted a frequency tone which was predictably specific; this tone could only be received by a receiver tuned to the frequency of the transmitter. With this system it is possible to have 23 separate channels over each telephone circuit. In addition, bidirectional transmission is easily accomplished. If it is necessary to transmit flow on a real time basis, i.e., the recorder teachs the transmitter unit basis, i.e., the recorder tracks the transmitter with no discernible delay, then a different approach must be applied. With a method known as variable rate frequency shift analog telemetry, all common analog measure-ments can be 'instantaneously' transmitted over ments can be 'instantaneously' transmitted over telephone lines and all types of radios. Digital telemetry or coded pulse telemetry is another tech-nique rapidly being incorporated into every facet of cmmerical activities, along with radio communi-cation in the form of microwave and FM systems. In addition to the cheaper cost of radio transmis-sion, wireless transmission has the advantage of being largely immune from the direct impact of structural damage from storms and high winds, and solid state electronics has elevated the general reliability of radio communications to a level not achievable with telephone systems. (Sand-PTT) W90-06729

USE OF A THERMAL SCANNER IMAGE OF A WATER STRESSED CROP TO STUDY SOIL SPATIAL VARIABILITY.

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). For primary bibliographic entry see Field 2G. W90-06737

ESTIMATING TOTAL DAILY EVAPOTRAN-SPIRATION FROM REMOTE SURFACE TEM-PERATURE MEASUREMENTS.

Pennsylvania State Univ., University Park. Dept. of Meteorology.

For primary bibliographic entry see Field 2D. For primary W90-06738

PERFUSED FISH GILL PREPARATION IN STUDIES OF THE BIOAVAILABILITY OF CHEMICALS.

Uppsala Univ. (Sweden). Dept. of Zoophysiology. For primary bibliographic entry see Field 5A. W90-06795

STRONTIUM:CALCIUM CONCENTRATION RATIOS IN OTOLITHS OF HERRING LARVAE AS INDICATORS OF ENVIRONMEN-TAL HISTORIES.

Hawaii Inst. of Geophysics, Honolulu. Oceanic Biology Div. R. L. Radtke, D. W. Townsend, S. D. Folsom, and

M. A. Morrison. Environmental Biology of Fishes EBFID3, Vol. 27, No. 1, p 51-61, January 1990. 4 fig, 2 tab, 45 ref.

Descriptors: *Bioindicators, *Calcium, *Herring, *Marine environment, *Strontium, *Temperature, Bioassay, Environmental history, Otoliths.

Elemental analyses, using wave-length dispersive electron microprobe techniques on otoliths from reared Atlantic herring larvae, Clupea harengus, showed trace quantities of strontium relative to that of calcium, and an inverse relationship betinat or calcium, and an inverse relationship be-tween Sr/Ca concentration ratios and rearing tem-perature. These data are consistent with those for coral aragonite, in that there appears to be an inverse temperature effect on physiological incor-poration of strontium in the otolith aragonite. The determinations of Sr/Ca concentration ratios of lab-reared herring larvae showed that the deposiinto rearrow nerring larvae sonwed that ne deposi-tion of strontium relative to calcium and the rear-ing temperature were related, where: temperature (Celsius) = -2.955 (Sr/Ca) x 1000 + 19.172. This principle makes it possible to use Sr/Ca concentra-tion ratios in fish otoliths to delineate past temperation ratios in fish otoliths to delineate past tempera-tures experienced by an individual. Further, com-bining electron microprobe analyses with scanning electron microscope examinations of daily incre-electron microscope examinations of daily incre-ments in the same otolith makes it possible to reconstruct the temperature history for an individ-ual fish on a time scale of days. (Author's abstract) W90-06797

INFILTRATION EVALUATION OF FOUR ME-CHANICAL RAINFALL SIMULATION TECH-NIQUES IN SIERRA NEVADA WATERSHEDS, Nevada Univ., Reno. Dept. of Range, Wildlife and

ry. Guerrant, W. W. Miller, C. N. Mahannah,

and R. Narayanan. and R. Narayanan. Water Resources Bulletin WARBAQ, Vol. 26, No. 1, p 127-134, February 1990. 6 fig, 3 tab, 27 ref.

Descriptors: *Infiltration, *Model studies, *Rainfall infiltration, *Rainfall simulators, *Sierra Nevada, *Simulated rainfall, Slopes, Soil types, Storms, Tahoe Basin.

Little quantitative site-specific infiltration, runoff and sediment transport data for Tahoe Basin soils under varying storm events or stage of develop-ment are available. Modular (MI), F-type (M2), Impact nozzle (M3), and Impact-Fan nozzle (M4) rainfall simulators were evaluated as to their pracrainfall simulators were evaluated as to their practicality and ability to characterize infiltration for the Cagwin Soil Series within the Tahoe Basin. Three slope (0-15, 15-30, >30 ppt) and four plot conditions (natural with duff, natural without duff, disturbed with duff). disturbed without dulf, and disturbed with dulf) were studied. The measured data were incorporated into a modified Philip's infiltration model and multiple non-linear regression analyses were used to examine relationships between method, slope, plot conditions, and infiltration characteristics. Simulation methods MI and M4 produced statistically similar (P=0.01) infiltration data, as did M2 which sendered lower infiltration refresher to the cally similar (P=0.01) infiltration data, as did M2 and M3 which produced lower infiltration rates. All were found suitable for use in Sierra Nevada watersheds. M1 was considered most practical. Slope had negligible effect on infiltration. The plot condition was found to significantly influence infiltration, and the effect of each plot condition was significantly different. Final infiltration rates ranged from 4.7 to 6.2 cm/hr. Thus, the Cagwin soil demonstrated moderate to high infiltration rates even when exposed to extreme storm condirates even when exposed to extreme storm conditions (8-10 cm/hr). (Author's abstract) W90-06829

DEUTERIUM VARIATIONS IN STORM RAIN-FALL: IMPLICATIONS FOR STREAM HY-DROGRAPH SEPARATION.

Universities Space Research Association, Huntsville, AL.

For primary bibliographic entry see Field 2B. W90-06854

SIMPLE SUBSAMPLING DEVICE FOR MACROINVERTEBRATES WITH GENERAL REMARKS ON THE PROCESSING OF STREAM BENTHOS SAMPLES.

Konstanz Univ. (Germany, F.R.). Limnological E. Meyer.

Archiv fuer Hydrobiologie AHYBA4, Vol. 117, No. 3, p 309-318, January 1990. 3 fig, 1 tab, 29 ref.

Descriptors: *Bottom sampling, *Macroinverte-brates, *Samplers, *Stream biota, Benthos, Biologi-cal samples, Sample preparation, Streams, Zoo-plankton.

A simple and inexpensive device was developed to subdivide benthos samples without the necessity of separating the animals from the substrate. The tubular subsampler is a compartment-type splitter with two chambers of equal size. Prior to subsampling, the initial benthos sample must be separated into a coarse and a fine fraction, with the coarse fraction being sorted out completely. Only the fine fraction is repeatedly subjected to the splitting procedure until the desired level of subsampling is reached. The subsampler works with live stream invertebrates, but also is recommended for preserved material and zooplankton. (Author stract) W90-06878

DIRECT AND BOUNDARY-ONLY SOLU-TIONS OF MULTILAYER AQUIFER SYS-TEMS: PART B. UNSTEADY-STATE SOLU-TION.

Georgia Inst. of Tech., Atlanta. School of Civil

Engineering.
For primary bibliographic entry see Field 2F.
W90-06887

OPTIMIZATION MODEL FOR UNCONFINED STRATIFIED AQUIFER SYSTEMS.

Utah Water Research Lab., Logan. For primary bibliographic entry see Field 2F. W90,06891

SPATIAL VARIABILITY OF GROUNDWATER RECHARGE IN A SEMIARID REGION.
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2F. W90-06894

POTENTIAL USE OF DEEP AQUIFERS IN THE NEGEV DESERT, ISRAEL: A MATHEMATICAL MODEL AND ITS NUMERICAL SO-

Hebrew Univ. of Jerusalem (Israel). Seagram Centre for Soil and Water Sciences. For primary bibliographic entry see Field 2F. W90-06900

APPROXIMATE ANALYSIS OF SURFACE RUNOFF MODEL UNCERTAINTY. Williamson and Schmid, Irvine, CA. For primary bibliographic entry see Field 2E.

COORDINATION CHEMISTRY AND SPECIA-TION OF AL(III) IN AQUEOUS SOLUTION. Texas A and M Univ., College Station. Dept. of

Chemistry.
A. E. Martell, and R. J. Motekaitis.
IN: Environmental Chemistry and Toxicology of Aluminum. Lewis Publishers, Chelsea, Michigan.
1989. p 3-17, 4 fig., 4 tab., 29 ref.

Descriptors: *Aluminum, *Chemical speciation, *Geochemistry, *Metal complexes, *Water analysis, *Water chemistry, Amino acids, Carboxylation, Distribution graphs, Equilibrium, Hydrogen ion concentration, Hydrolysis, Ions, Oxidation, Potentiometers, Solute transport, Spectrophotometry.

An important consideration in the design of effec-tive ligands for hard metal ions such as that of Al(III) is competition with hydrogen ions in aque-ous solution. The reliable quantitative data current-ly available on the Al(III) complexes formed in

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solution were examined with respect to the nature of the complex species probably formed. The scope was limited to the catechols and hydroxy carboxylates, which are the most effective ligands carooxylates, which are the most effective figands, and the aminocarboxylates, which are expected to be somewhat less effective. Most of the equilibrium constants presented were measured potentiometrically, except for a few dissociation constants of the cally, except for a few dissociation constants of the catechols, which were measured spectrophotome-trically. The Al(III) aquo ion is the 'hardest' of the trivalent ions commonly found in the environment and in biological systems. Because of its small ionic radius, Al(III) polarizes solvated water molecules radius, Al(III) polarizes solvated water molecules very strongly, giving rise to several hydrolytic species. The highest stability constants for Al(III) complexes are those of catechol and its analogs. The aminopolycarboxylate ligands contain less strongly coordinating carboxylate groups. By anal-ogy with other hydroxy acids it is clear that the ogy with other hydroxy acts it is clear that the malate ion forms one or more stable complexes involving dissociation of the alpha-hydroxyl group. Since aluminum is such an important ele-ment, and since it has only one oxidation state, its ment, and since it has only one oxidation state, its activity, reactivity, and transport are related mainly to its coordination chemistry. Ligand-ligand competition distribution diagrams provide examples of the use of accurate stability constant data to describe the nature of the complexes formed as a function of pH and other solution conditions. (See also W90-06929) (Fish-PTT) W90-06930

SPECIATION METHOD FOR PARTITIONING MONONUCLEAR AND POLYNUCLEAR ALU-MINUM USING FERRON.

Oak Ridge National Lab., TN. Environmental Sci-For primary bibliographic entry see Field 5A. W90-06931 ences Div.

FIELD HYDROGEOLOGY.

North West Water Authority, Warrington (England). Planning Dept.
For primary bibliographic entry see Field 2F. W90-06942

QUALITY ASSURANCE AUDITS OF THE EPA STATE-OPERATED PRECIPITATION COL-LECTION NETWORK: 1987.

Research Triangle Inst., Research Triangle Park, NC

W. C. Eaton, C. E. Moore, R. W. Murdoch, and D. A. Ward.

A. Ward.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-161954.
Price codes: A04 in paper copy, A01 in microfiche.
Report No. EPA/600/3-89/024, March 1989. 5p, 6
fig. 15 tab, 8 ref, 2 append. EPA Contracts 68-024125 and 68-D8-0001.

Descriptors: *Data acquisition, *Data quality control, *Measuring instruments, *Meteorological data, *Precipitation, *Quality assurance, *Rain gages, Acid rain, Conductivity, Field tests, Hydroen ion concentration. Networks

The collection of precipitation and the measurement of its constituents are important steps in attaining a better understanding of the distribution and effects of acid rain in the United States. This document is a report of the findings from quality assurance and technical assistance visits made in 1987 to the 29 sites in 11 states that comprise the State Operated Precipitation Network. The network is staffed mainly by personnel from state environmental agencies and forestry commissions. It is under the overall sponsorship of regional and national offices of the US EPA. A number of the sites still need to be improved upon in terms of stiling and maintenance of sample collection and sucs sun need to be improved upon in terms of siting and maintenance of sample collection and analysis equipment. Emphasis should be placed on proper placement and operation of precipitation collectors, installation and proper operation of rain gages, and standardization of field laboratory techniques. Compared to results of the 1986 site visits, the 1987 data show significant improvements have been made in the accuracy of site pH and conduc-tivity measurements; in the cleanliness of the col-lection bucket lid and the goodness of its seal against the collection bucket; and in satisfying the

criteria for collector height above ground and in relation to the rain gage. (Lantz-PTT)

COMMON ANALYTICAL ERRORS IN THE RADIODATING OF RECENT SEDIMENTS. National Water Research Inst., Burlington (Ontar-io). Lakes Research Branch. For primary bibliographic entry see Field 2J. W90-06964

DILUTION MIXING ESTIMATES OF TRACE METAL CONCENTRATIONS IN SUSPENDED

Maryland Univ., College Park. Dept. of Geography.
For primary bibliographic entry see Field 5A.
W90-06966

THEORETICAL ANALYSIS AND METEORO-LOGICAL INTERPRETATION OF THE ROLE OF RAINDROP SHAPE ON MICROWAVE AT-TENUATION AND PROPAGATION PHASE SHIFTS: IMPLICATION FOR THE RADAR MEASUREMENT OF RAIN. Applied Research Corp., Landover, MD. A P. James

Applied Research Corp., Daniel Corp., A. R. Jameson.
Journal of Atmospheric and Oceanic Technology
JAOTES, Vol. 6, No. 1, p 76-88, February 1989. 12 fig, 34 ref.

Descriptors: *Meteorological data collection, *Polarization, *Radar, *Rain, *Rainfall distribution, *Remote sensing, Microwave attenuation, Propagation phase shift.

In rain, radar can measure various powers of the drop diameter averaged over the drop size distribution. These averages can then be used to infer water content or the rainfall rate in still air. Radar parameters are also functions of the shapes of raindrops. In particular, raindrop shape is known to affect both attenuation and propagation phase shift at vertical and horizontal linear polarizations. While the effect of raindrop shape on these quanti-While the effect of raindrop shape on these quantities is understood qualitatively, its role has not previously been investigated analytically. In this work, raindrops are assumed to be oblate spheroids with shapes specified by an axis ratio of the smallest to largest dimension. The impact of raindrop shape is evident in analytic expressions derived from detailed numerical scattering computations for drops from 0.01 to 0.6 cm diameter and over a range of axis ratios. These experiments reveal how the axis ratio can produce significant differences in attenuation and phase shift between measurements at horizontal and vertical polarization while simulaneously inducing only minor perturbations in taneously inducing only minor perturbations in these qualities at each polarization separately. These also suggest that the effect of raindrop shapes on attenuation and propagation phase shift can be removed by summing the rates at both vertical and horizontal linear polarizations. For wavelength greater than a few cm, radars do not wavelength greater than a few cm, radars do not directly measure rain water content or rainfall rate in still air. Instead these quantities can only be inferred after invoking assumptions about the shapes and size distribution of the raindrops. This study, showed the rate of change with distance of sum of propagation phase shifts at vertical and horizontal linear polarization to be directly proportional to the liquid water content for radar wavelengths greater than 2.2 cm. Unfortunately, while the relation between the rate of change and the lengths greater than 2.2 cm. Unfortunately, while the relation between the rate of change and the rain water content is independent of the drop size distribution and raindrop shapes, the rate of change cannot be measured. For wavelengths greater than two cm, radar can not directly measure rainfall. Hence, rain water content and the rainfall rate in still air must be inferred from interpolations among radar observables. The best estimates of rainfall are most likely to be derived using a combination of many different polarization and attenuation tech-niques. (Author's abstract) W90-06967

STEREORADAR METEOROLOGY: A PROM-ISING TECHNIQUE FOR OBSERVATION OF PRECIPITATION FROM A MOBILE PLAT-

Centre de Recherches en Physique de l'Environne-ment, Issy-les-Moulineaux (France). For primary bibliographic entry see Field 2B. W90-06968

MINISODAR MEASUREMENTS OF RAIN. Centre for Environmental Research, Biological, Environmental, and Medical Research Division, Argonne National Laboratory, Argonne, Illinois. For primary bibliographic entry see Field 2B. W90-06969

EVALUATION OF LIQUID WATER MEASUR-ING INSTRUMENTS IN COLD CLOUDS SAM-PLED DURING FIRE.

National Center for Atmospheric Research, Boulder, CO. For primary bibliographic entry see Field 2B. W90-06970

COMPARISON OF SIMULATED RAIN RATES FROM DISDROMETER DATA EMPLOYING POLARIMETRIC RADAR ALGORITHMS. For primary bibliographic entry see Field 2B. W90-06971

DETERMINATION OF RAIN INTENSITY FROM DOPPLER SPECTRA OF VERTICALLY SCANNING RADAR

Telecommunications Systems Group, Delft, The Netherlands. For primary bibliographic entry see Field 2B. W90-06972

EXPERIMENTAL TESTS OF METHODS FOR THE MEASUREMENT OF RAINFALL RATE USING AN AIRBORNE DUAL-WAVELENGTH

RADAR

NAIDAR. National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. For primary bibliographic entry see Field 2B. W90-06973

SOIL THERMAL EMISSIVITY AS AFFECTED BY ITS WATER CONTENT AND SURFACE TREATMENT.

Academia Sinica, Beijing (China), Inst. of Geogra-For primary bibliographic entry see Field 2G. W90-06984

TALL FESCUE GROWTH IN GREENHOUSE, GROWTH CHAMBER, AND FIELD PLOTS AMENDED WITH SEWAGE SLUDGE COMPOST AND FERTILIZER.

AGIL FERTILIZER. Agricultural Research Service, Beltsville, MD. Soil-Microbial System Lab. For primary bibliographic entry see Field 5E. W90.06986

EVALUATION OF METHODS FOR DETERMINING THE VERTICAL DISTRIBUTION OF

HYDRAULIC CONDUCTIVITY.
Nevada Univ. System, Reno. Desert Research Inst.
K. Taylor, S. Wheatcraft, J. Hess, J. Hayworth, and F. Molz.

and F. Moiz. Ground Water GRWAAP, Vol. 28, No. 1, p 88-98, January/February 1990. 9 fig, 36 ref.

Descriptors: *Boreholes, *Data acquisition, *Fracture permeability, *Geologic fractures, *Groundwater movement, *Hydraulic conductivity, *Packses, *Tracers, Electrical studies, Fluid mechanics, Geohydrology, Geologic formations, Hydraulic properties, Injection wells, Interstitial water, Performance evaluation, Well screens.

Six borehole methods for determining the vertical distribution of hydraulic conductivity in unconsolidated geologic formations were evaluated. Strad-dle packer tests are inappropriate if there is a hydraulic path around the packer on the outside of the well screen. Methods based on grain-size analy-

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sis fail to incorporate the influence of small-scale structure and packing. Methods based on relation-ships between electrical and hydraulic conductivi-ty require special conditions and are site-specific and formation-specific. Borehole effects invalidate methods based on the natural flow of fluid through a well bore. Stoneley wave attenuation methods are not effective in unconsolidated formations. A single-well electrical tracer test is effective, but single-well electrical tracer test is elective, out requires the injection of significant volumes of fluid. (Author's abstract)
W90-07018

DEVELOPMENT OF A SYSTEM TO ESTI-MATE EVAPOTRANSPIRATION OVER COM-PLEX TERRAIN USING LANDSAT MSS, ELE-VATION AND METEOROLOGICAL DATA. Tsukuba Univ. (Japan). Science Information Processing Center.

For primary bibliographic entry see Field 2D. W90-07022

IMPORTANCE OF BIOASSAY VOLUME IN TOXICITY TESTS USING ALGAE AND AQUATIC INVERTEBRATES.

Nova Scotia Agricultural Coll., Truro. Environ-mental Microbiology Lab. For primary bibliographic entry see Field 5C. W90-07029

IN VITRO CYTOTOXICITIES OF INORGANIC LEAD AND DI AND TRIALKYL LEAD COMPOUNDS TO FISH CELLS. Rockefeller Univ., New York. Lab. Animal Re-

search Center.
For primary bibliographic entry see Field 5C.
W90-07034

ESTIMATING CLIMATIC-SCALE PRECIPITA-TION FROM SPACE: A REVIEW.

National Oceanic and Atmospheric Administra-tion, Washington, DC. Climate Analysis Center. P. A. Arkin, and P. E. Ardanuy. Journal of Climate JLCLEIL, Vol. 2, No. 11, p 1229-1238, November 1989. 3 fig, 68 ref.

Descriptors: *Atmospheric water, *Climates, *Cloud liquid water, *Precipitation, *Rainfall, *Remote sensing, *Reviews, *Satellite technology, Climatology, Clouds, Weather.

Measurement of climatic-scale precipitation (defined as averages over ares of > 10,000 sq km and periods fo five days or longer) is impractical for many areas of the earth without the use of space-based observations. The history of satellite rainfall estimation schemes is reviewed, as well as the schemes' application to climate studies. Two approaches, direct and indirect, have dominated work until very recently, when attempts to use more integrated techniques began. Indirect schemes, primarily based on visible and infrared (IR) observations of the characteristics of clouds, have been used in the majority of such studies. (IR) observations of the characteristics of clouds, have been used in the majority of such studies. Direct schemes, such as those that use microwave observations of raindrop-sized hydrometeors, have been limited by a relative lack of the required measurements. A large number of studies have used datasets not originally intended as precipitation estimates at all, such as the NOAA outgoing longwave radiation data, to produce estimates of very large scale rainfall. Current and prospective attempts to overcome some of the difficulties afattempts to overcome some of the difficulties af-fecting climatic-scale precipitation estimation are reviewed. The Global Precipitation Climatology Project will integrate data from surface observa-tions, geostationary IR sensors, and polar-orbiting microwave and IR sensors to product near-global analyses of monthly rainfall. The proposed Tropi-cal Rainfall Measuring Mission will use a single satellite with an instrument package that will make visible, IR, and microwave radiometric observa-tions. The package will also include a precipitation tions. The package will also include a precipitation radar. Other proposed satellite missions and interradar. Other proposed satellite missions and inter-national programs, such as the new series of NOAA polar orbiters containing Advanced Micro-wave Sounding Units, and their contributions to the production of climatic-scale precipitation esti-mates, are reviewed. The development of a global

rainfall analysis system is proposed, which might incorporate visible, IR, and microwave satellite data together with conventional observations in an algorithm. (Author's abstract) W90-07073

HERBIVORES AND THE SPATIAL DISTRIBU-TION OF THE PHYTOPLANKTON: II, ESTI-MATING GRAZING IN PLANKTONIC ENVI-

RUNMENTS.
Brookhaven National Lab., Upton, NY. Oceano-graphic Sciences Div.
For primary bibliographic entry see Field 2L.
W90-07097

NEW TECHNOLOGIES HELP HOUSTON IN-SPECT ITS SEWERS. Houston Dept. of Public Works, TX. For primary bibliographic entry see Field 5D. W90-07105

INFILTRATION IN SATURATED SWELLING SOILS AND SLURRIES: EXACT SOLUTIONS FOR CONSTANT SUPPLY RATE.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G. W90-07107

RESPONSE OF FRESHWATER ALGA SCENEDESMUS TO TRIAZINE HERBICIDES. National Research Centre, Cairo (Egypt). Water Pollution Control Lab. For primary bibliographic entry see Field 5C. W90-07128

ACCUMULATION OF COPPER IN CLARIAS ANGUILLARIS L. AND OREOCHROMIS NI-

Almadu Bello Univ., Zaria (Nigeria). Dept. of Biological Sciences. For primary bibliographic entry see Field 5B. W90-07132

SNOWFALL CHEMISTRY COLLECTOR IN-TERCOMPARISON TEST (SCCIT).

Argonne National Lab., IL. Environmental Research Div.
D. L. Sisterson, J. D. Shannon, P. H. Daum, P. J.
Klotz, and D. J. Luecken.
Water, Air and Soil Pollution WAPLAC, Vol. 48,
No. 3/4, p 477-488, November 1989. 3 tab, 19 ref,
append.

Descriptors: "Acid rain, "Instrumentation, "Precipitation samplers, "Sampling, "Snow samplers, "Snow sampling, "Water chemistry, "Water depth, Chemical composition, Chemistry of precipitation, Comparison studies, Hydrogen ion concentration, New York, Sulfates.

The Snowfall Chemistry Collector Intercom son Test (SCCIT) took place as part of a field experiment of the Processing of Emissions by Clouds and Precipitation (PRECP) program during January and February 1986 in western New York. SCCIT compared the chemical composition and acquired the processing of the pr and equivalent water depth of snow collected with a large bag-lined can (used by the PRECP commu-nity for a concurrent surface snowfall network); nity for a concurrent surface snowfall network); the most widely used wet/dry collector; an aero-dynamically designed, heated, funnel and bottle system; and a large plastic sheet. The aerodynamically designed system had significantly higher concentrations of analytes than the other systems, particularly hydrogen ions and sulfate ions, apparently because of evaporative losses. Samples from the bag-lined can were more acidic than those from oag-meu can were more acidic than those from the automatic wet/dry collector. The aerodynami-cally designed system and the bag-lined can indi-cated greater snow amounts than the other meth-ods. (Author's abstract) W90-07133

RAPID LAKE MAPPING USING A PORTABLE LASER RANGEFINDER.

Ghent Rijksuniversiteit (Belgium). Inst. of Animal

Ecology.
L. Brendonck, O. M. Ali, D. Claeys, A. El Moghraby, and H. J. Dumont.
Hydrobiologia HYDRBS, Vol. 185, No. 2, p 145-151. November 1989, 5 fig. 4 ref.

Descriptors: *Instrumentation, *Lake morphology, *Lakes, *Lasers, *Mapping, *Rangefinders, *Remote sensing, Bathymetry, Mountain lakes, Springs, Wells, West Sudan.

The LRF 104 is a lightweight, yet rugged range-finder, approximately the size of 7 x 35 binoculars, weighing less than 1 kg. It is an Nd-Yag laser system with a range capability of 9995 m. The instrument uses the time from a transmitted laser pulse to receipt of reflected light from a target to determine a distance, which is read directly from a digital display. The instrument has a constant accu-racy of maximum + 3 m/sigma across its entire digital display. The instrument has a constant accuracy of maximum +3 m/sigma, across its entire range. As an example of lake mapping, the Malha crater in Darfur, West Sudan, containing a lake, springs, wells, and vegetation, was mapped. The LRF 104 was found to be extremely useful in mapping both the crater and lake of Malha. The instrument was as easy to operate as to carry. Furthermore, a type provided with a built-in goniometer and north-seeker also exists. In principle, ometer and north-seeker also exists. In principle, this should make measuring even less time-consuming, but the fact that it is heavier, bigger in size, and more expensive, makes the LRF 104 more attractive as field equipment, especially in mountains, semi-isolated regions, and special environments such as caves, archeological sites, and nature parks of moderate dimensions. (Mertz-PTT) W90-07154

SIDE-SCAN SONAR MAPPING OF LAKE TROUT SPAWNING HABITAT IN NORTHERN LAKE MICHIGAN.

National Fisheries Research Center-Great Lakes, Ann Arbor, MI. T. A. Edsall, T. P. Poe, R. T. Nester, and C. L.

Brown.

North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 3, p 269-279, Summer 1989. 10 fig, 30 ref.

Descriptors: *Aquatic habitats, *Great Lakes, *Mapping, *Sonar, *Subsurface mapping, *Trout, Fish establishment, Fish management, Fish stocking. Lakes, Substrates

Native stocks of lake trout Salvelinum namaycush were virtually or completely extirpated from the lower four Great Lakes by the early 1960s. The failure of early attempts to reestablish self-sustaining populations of lake trout was attributed partly to the practice of stocking hatchery-teared juveniles at locations and over substrates that had not niles at locations and over substrates that had not been used in the past for spawning by native fish. Subsequent attempts to improve the selection of stocking locations were impeded by the lack of reliable information on the distribution of sub-strates on historical spawning grounds. A study was conducted to demonstrate the potential of side-scan sonar to substantially expand the data base needed to pinpoint the location of substrates d the data base needed to pinpoint the location of substrates where lake trout eggs, fry, or juveniles could be stocked to maximize survival and help ensure that survivors returning to spawn would encounter suitable substrates. Side-scan sonar mapping was conducted in 1984 with an EQ & G model SMS 960 microprocessor, a model 272 100-kHz towfish, and a model 9000 magnetic tape deck. In 1985, the more advanced EQ & G model 260 microprocessor, a model 272-T 100-kHz towfish equipped with time-variety gain and a model 360 divisial tape deck time-varied gain, and a model 360 digital tape deck was used. Both systems directed an acoustic beam from the towfish to the lake bed; the acoustic signal returning from the lake bed was received and amplified by the towfish and transmitted to the microprocessor, where it was converted into a continuous strip-chart record on which surficial lake-bed features were shown in the planar view. The substrates and bathymetry of large areas on historical lake trout spawning grounds in the Fox Island Lake Trout Sanctuary in northern Lake Michigan were evaluated. It was found that these areas could be used to support a contemporary

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self-sustaining lake trout population in the sanctu-ary and perhaps also in adjacent waters. (Mertz-W90-07179

EFFECTS OF WATER TEMPERATURE ON THE MORTALITY OF FIELD-COLLECTED FISH MARKED WITH FLUORESCENT PIG-

National Fisheries Research Center, La Crosse, WI

L. E. Holland-Bartels, M. R. Dewey, and S. J. Zigler

North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 3, p 341-344, Summer 1989. 2 tab. 10 ref.

Descriptors: *Data collections, *Field tests, *Fish-kill, *Minnow, *On-site investigations, *Tempera-ture effects, *Water temperature, Centrarchids, Fluorescent pigments, Percids, Rivers.

The cumulative effects of collection, handling, and marking with fluorescent pigment on the mortality of adult minnows, young-of-the-year centrarchids, and large contrarchids and percids was determined at five water temperatures (10-20.6 C) in field trials. There have been few field trials of this type. trials. There have been few field trials of this type. The mortality of centrarchids and percids was directly related to temperature and decreased noticeably when the temperature was below 19.5 C. The mortality of minnows decreased somewhat as river temperatures cooled but was always at least 50%. Variation was high in the temperature-related patterns of mortality in different taxa and sizes of fish. This variation complicates the accuracy and usefulness of pigment in marking field-collected fish for mark-recapture studies in warmwater systems. (Author's abstract) W90-07183

SPLIT-STEP FOURIER ALGORITHM FOR WATER WAVES,

Delaware Univ., Newark. Ocean Engineering Pro-

gram.
For primary bibliographic entry see Field 8B. W90-07200

APPLICATION OF BIOASSAY TECHNIQUES TO WATER POLLUTION PROBLEMS. THE TO WATER POLLUTION PROBLEMS—THE UNITED KINGDOM EXPERIENCE. River Purification Board, East Kilbride (Scotland).

For primary bibliographic entry see Field 5A. W90-07254

FUNCTIONAL BIOASSAYS UTILIZING ZOO-PLANKTON: A COMPARISON.

Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
For primary bibliographic entry see Field 5A.
W90-07257

ROUND ROBIN TESTING WITH THE SELEN-ASTRUM CAPRICORNUTUM MICROPLATE TOXICITY ASSAY. Department of the Environment, Sainte-Foy (Quebec).

For primary bibliographic entry see Field 5A. W90-07272

METHOD FOR STUDYING THE IMPACT OF POLLUTED MARINE SEDIMENTS ON INTERTIDAL COLONISING ORGANISMS; TESTS WITH DIESEL-BASED DRILLING MUD AND TRIBUTYLTIN ANTIFOULING MUD AND PAINT.

Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab. For primary bibliographic entry see Field 5A. W90-07295

SCOPE FOR GROWTH IN GAMMARUS PULEX, A FRESHWATER BENTHIC DETRITI-VORE.

Sheffield Univ. (England). Dept. of Animal and

For primary bibliographic entry see Field 5A. W90-07298 Plant Sciences

FEEDING AND NUTRITIONAL CONSIDER-ATIONS IN AQUATIC TOXICOLOGY. Waterloo Univ. (Ontario). Dept. of Biology. For primary bibliographic entry see Field 5C. W90-07299

IMPROVED ELUTRIATION TECHNIQUE FOR THE BIOASSESSMENT OF SEDIMENT CONTAMINANTS.

Waterloo Univ. (Ontario). Dept. of Biology. For primary bibliographic entry see Field 5A. W90-07309

SORPTION AND TRANSPORT OF PESTI-CIDES IN GROUND WATER: CRITICAL REVIEW.

Neview. Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science. For primary bibliographic entry see Field 5B. W90-07315

VALIDATING GLEAMS WITH FIELD DATA FOR FENAMIPHOS AND ITS METABOLITES.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5B.

SYSTEMATIC PROCEDURE FOR EVALUATING PARTIAL AREAS OF WATERSHED RUNOFF.

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.

For primary bibliographic entry see Field 2E.

VARIABLE-RATE PUMPING TESTS FOR RA-DIALLY SYMMETRIC NONUNIFORM DIALLY AQUIFERS.

AQUIFERS.

J. Butler, and C. D. McElwee.

Water Resources Research WRERAQ, Vol. 26, No. 2, p 291-306, February 1990. 16 fig. 4 tab, 13

Descriptors: *Aquifers, *Data acquisition, *Groundwater movement, *Pumping tests, Prediction, Sensitivity analysis, Spatial distribution, Vari-

Conventional pumping test methodology is of limited effectiveness in defining the spatial distribution of aquifer properties because of the nonuniqueness of the parameter estimates. Sensitivity analysis can be used to develop a pumping test procedure that significantly decreases the uncertainty associated with the estimated parameters. This approach employs systematic variations in pumpage rates to achieve reductions in parameter uncertainty. These reductions are obtained by increasing the sensitivi-ty of drawdown to flow properties while simultaneously constraining the growth in the correlation between the effects of different flow properties on observation well drawdown. Numerical experiobservation well drawdown. Numerical experiments demonstrated the importance of the magnitude and frequency of rate variations, the spatial and temporal pattern of data collection, and the dependence of the technique on the total duration of the pumping test. Significant decreases in parameter uncertainty can be expected in any flow system in which the primary component of flow is in the radial direction. The present study demonstrates that sensitivity analysis can be an important strates that sensitivity analysis can be an important tool in the development of methodology for the characterization of subsurface properties. (Author's abstract)

COLD WATER INJECTION INTO SINGLE-AND TWO-PHASE GEOTHERMAL RESER-

S-Cubed, La Jolla, CA.

For primary bibliographic entry see Field 2F. W90-07361

SAMPLING BIAS CAUSED BY MATERIALS USED TO MONITOR HALOCARBONS IN GROUNDWATER.

Waterloo Univ. (Ontario). Dept. of Earth Sciences. For primary bibliographic entry see Field 5A.
W90-07368

STRUCTURAL STUDIES OF MARINE AND RIVERINE HUMIC MATTER BY CHEMICAL DEGRADATION.

Hamburg Univ. (Germany, F.R.). Geologisch-Pa-laeontologisches Inst. und Museum. W. Michaelis, H. H. Richnow, and A. Jenisch. Science of the Total Environment STENDL, Vol. 81/82, p 41-50, June 1989. 6 fig, 1 tab, 23 ref.

Descriptors: *Chemical analysis, *Chemical degradation, *Humic substances, *Organic carbon, Water analysis, Deuterium, Hydrocarbons, Organic compounds, Polymers, Separation tech-

Selective chemical degradations of humic substances from riverine and marine waters with nonoxidative reagents have revealed high amounts of low-molecular weight soluble material. Low temperature, low pressure catalytic hydrogenation releases considerable amounts of soluble products from high molecular weight material of geological origin while leaving carbon-carbon bonds uncleaved providing structurally unaltered moieties. A second reaction sequence cleaves ether and ester bonds by iodotrimethylsilane. Integral parts of biopolymers can be traced as building blocks of humic substances. Degradations performed with deuterium instead of hydrogen demonstrate characteristic deuterium incorporation into the degradation deuterium incorporation into the degradation products. When deuterium tracers are used, bondproducts. When deuterium tracers are used, obna-ing sites by which the biological precursor com-pounds are attached to the humic substance matrix can be determined. The amount of phenols re-leased from terrestrial and riverine humic sub-stances are 10 to 15 times higher than from the open ocean environment. The marine humic matter released mainly methylphenols indicating a signifi-cant phenol contribution from sources other than lignin. The hydrocarbons obtained from hydrogenolysis of humic acids from a Tertiary lignite, the River Elbe and the Northern Arabian Sea show different alkane distributions. (Geiger-PTT)

PY-GC-MS ANALYSIS OF ORGANIC MATTER IN SUSPENDED MATERIAL AND DEPOSITS OF THE SUB-MARINE DELTA OF THE RHONE RIVER (FRANCE).

Instituto Químico de Sarria, Barcelona (Spain). Dept. Química Analitica. A. Puigbo, F. Gadel, J. M. Alcaniz, and L. Comellas.

Science of the Total Environment STENDL, Vol. 81/82, p 71-80, June 1989. 5 fig, 2 tab, 9 ref.

Descriptors: *Chemical analysis, *Gas chromatography, *Mass spectrometry, *Organic matter, *Pyrolysis, *Suspended solids, *Water analysis, Aromatic compounds, Deltas, France, Fulvic acids, Humic acids, Marine sediments, Phenols, Polymers, Rhone River, Runoff.

A pyrolysis-gas chromatography-mass spectrometry technique was applied to the study of suspended material, trap sediment material, deposits and humic compounds in the northwest Mediterranean Sea (Gulf of Lions-Ecomarge Program). In the Rhone delta the nature of suspended material depends on depth and river regime. Off the river mouth an increase in nitrogenous compounds and pends on depth and river regime. Off the river mouth, an increase in nitrogenous compounds and aromatic hydrocarbons is observed in the pyro-grams of suspended material and deposits. The decrease of phenolics can be related to diminishing terrestrial runoff. Fulvic acids are enriched in ni-trogenous compounds and carbohydrates. Humic acids concentrate phenolic and aromatic hydrocar-bons. On the Catalonian coast the higher rate of nitrogenous substances in offshore sediments is ex-

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plained by outer sampling location. Aromatic hy-drocarbons are less abundant indicating fresher organic matter than the more evolved material of the Rhone river. (Author's abstract)

MAJOR AND TRACE ELEMENTS IN STAND-ARD AND REFERENCE SAMPLES OF AQUATIC HUMIC SUBSTANCES DETER-MINED BY INSTRUMENTAL NEUTRON AC-

TIVATION ANALYSIS (INAA).
National Inst. of Public Health, Oslo (Norway).

National list. of Fuller Freatth, Oslo (150 way). G. Riise, and B. Salbu.
Science of the Total Environment STENDL, Vol. 81/82, p 137-142, June 1989. 3 fig, 1 tab, 6 ref.

Descriptors: *Fulvic acids, *Humic acids, *Humic substances, *Neutron activation analysis, Dissolved solids, Mercury, Organic carbon, Silver, Trace ele-

Major and trace elements in four standard and reference samples of aquatic humic substances (Su-wannee River fulvic acid, Suwannee River humic acid, Nordic Reference fulvic acid and the NIVA-Concentrate) have been determined using instru-mental neutron activation analysis (INAA). The mental neutron activation analysis (INAA). The NIVA-Concentrate is isolated by low pressure and low temperature evaporation and includes all dissolved non-volatile carbon present in the water. The other three humic samples are isolated according to the IHSS standard methods and include approximately 50% of the dissolved organic carbon present in the water. Due to the isolation method the NIVA-Concentrate contains both the highest concentrations and the highest number of elements. Except for high levels of Ac and Hg in elements. Except for high levels of Ag and Hg in Suwannee River humic acid, there seems to be only minor differences between the different samples of aquatic humic substances isolated according to the IHSS standard method. (Author's abstract)

SPECTROSCOPIC AND COMPOSITIONAL COMPARATIVE CHARACTERIZATION OF LH.S.S. REFERENCE AND STANDARD FULVIC AND HUMIC ACIDS OF VARIOUS

Bari Univ. (Italy). Ist. di Chimica Agraria. N. Senesi, T. M. Miano, M. R. Provenzano, and G.

Science of the Total Environment STENDL, Vol. 81/82, p 143-156, June 1989. 8 fig, 1 tab, 20 ref.

Descriptors: *Chemical analysis, *Fulvic acids, *Humic acids, *Organic acids, *Spectroscopy, *Water analysis, Aromatic compounds, Organic carbon, Organic compounds, Oxygen, Pollutant

Eleven standard and reference fulvic acids and Eleven standard and reference fulvic acids and humic acids of aquatic and terrestrial origin from the collection of the International Humic Substances Society have been studied by chemical and spectroscopic methods. Aquatic humic acids appear richer in oxygen and lower in carbon than terrestrial humic acids, while the opposite is generally true for the corresponding fulvic acids. The mitrogen content of aquatic samples is always much lower, and C/N ratio and ratios of absorbance at 465 and 665 angeometers much higher than those of 465 and 665 nanometers much higher than those of terrestrial samples. The infrared spectra of all sam-ples but soil humic acids are qualitatively similar one to another, but they differ mainly in the relaone to another, but they their mainly in the rela-tive intensity of carboxyl, aromatic and aliphatic group bands. Fluorescence of terrestrial humic acids occurs at higher wavelengths than terrestrial fulvic acids and aquatic humic acids and fulvic acids in both emission and excitation modes, while synchronous-scan spectra appear more resolved and informative. Electron spin resonance spectra are featured by resonances consistent with conjugated semiquinone free radicals and Fe(III) ions, the latter resonance being generally more intense for terrestrial than for aquatic samples. (Author's abstract) W90-07372

COMPARISON OF MOLECULAR WEIGHT DISTRIBUTION AND ACID/BASE PROPER-

TIES BETWEEN THE IHSS NORDIC FULVIC ACID AND WHOLE WATER HUMIC SUB-STANCES.

National Inst. of Public Health, Oslo (Norway). For primary bibliographic entry see Field 2K. W90-07382

ANALYSIS OF HUMIC AND LIGNIN COM-ANALYSIS OF HUMIC AND LIGHIN COM-POUNDS IN THE NORTHERN BALTIC SEA. National Board of Waters, Helsinki (Finland). I. Maekinen, and E. L. Poutanen. Science of the Total Environment STENDL, Vol.

81/82, p 329-334, June 1989. 2 fig, 2 tab, 5 ref.

Descriptors: *Baltic Sea, *Chemical analysis, *Fluorescence, *Humic substances, *Lignin, *Pollutant identification, *Pulp wastes, *Water analysis, Brackish water, Calcium, Magnesium, Organic

matter.

The use of synchronous fluorescence spectra for distinguishing natural fluorescence from the fluorescence caused by the organic discharges of lignin compounds in brackish water was investigated in water samples from the northern Baltic Sea. Water samples were collected from areas with a load of natural organic matter, as well as water from areas affected by waste discharge from pulp mills. An offset of 80 nanometers between the excitation and emission wavelengths was the most suitable for producing spectra with intensity maxima for lignin and humic compounds. The concentrations of Ca and Mg ions in brackish waters had only a slight effect on the natural fluorescence. The intensity values at 286 and 341 nanometers were recorded, respectively, for estimating the amounts of lignin and humic compounds. The amounts of lignin and humic compounds were calculated by a dual wavelength procedure. Spectra with intensity maxima length procedure. Spectra with intensity maxima for lignin and fulvic acid were in the excitation region 260-450 nanometers. The concentration of region 260-450 nanometers. The concentration of lignin compounds in the Gulf of Bothnia ranged from 1.1 to 2.3 mg/L. However, in the coastal areas close to pulp and paper mills very high values (5.0 mg/L) were occasionally obtained. The concentration of lignin compounds in the Gulf of Finland was higher than in the Gulf of Bothnia, ranging from 1.5 to 3.1 mg/L. (Geiger-PTT) W90-07383

MODELING SOLUTE TRANSPORT IN SOILS IN THE PRESENCE OF DISSOLVED HUMIC SUBSTANCES.

Substances.

Institut National de la Recherche Scientifique,
Sainte-Foy (Quebec).

For primary bibliographic entry see Field 5B.

W90-07401

BACTERIAL PRODUCTION IN FRESHWATER SEDIMENTS: CELL SPECIFIC SYSTEM MEASURES.

Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Central Research and Development Dept. For primary bibliographic entry see Field 2H. W90-07410

NITROGEN ANALYSES IN EUTROPHIC AL-KALINE AND PEATY WATERS: A COMPARI-SON OF DIFFERENT METHODS TO ANA-LYSE ANMONIA-NITROGEN. Limnologisch Inst., Oosterzee (Netherlands). Tjeu-

M. A. Kramer, J. R. Moed, and H. de Haan. Water Research WATRAG, Vol. 24, No. 2, p 221-224, February 1990. 3 fig, 1 tab, 17 ref.

Descriptors: *Ammonia, *Eutrophic lakes, *Lim-nology, *Peat, *Water analysis, Aluminum oxide, Ammonia oxidation, Comparison studies, Gluta-mate dehydrogenase, Organic nitrogen, Salicylate, The Netherlands.

Because of problems of ammonia determination in eutrophic and peaty Lake Tjeukemeer, The Neth-erlands, different methods of analysis—(a) the salic-ylate method; (b) the classic distillation procedure at alkaline pH; (c) the method of oxidizing ammo-nia to nitrite; and (d) the glutamate dehydrogenase method--were compared. Prior to salicylate addi-

tion or ammonia oxidation to nitrite, the peaty samples-filtered and buffered at pH 6.5 to avoid ammonia losses-were led through an aluminum oxide-column of the same pH to remove interfering substances. In this way the results of the salicylate method fitted best with those of the specific enzymatic method. The aluminum oxide treatment also makes the salicylate method applicable to eutrophic and humic water containing high concentrations of organic nitrogen. (Author's abstract) W90-07424.

DRUM CENTRIFUGATION MODELLING OF LONG TERM POLLUTANT MIGRATION THROUGH A SOIL LAYER.

Cambridge Univ. (England). Dept. of Engineering. For primary bibliographic entry see Field 5B. W90-07465

EXTRACTION OF WATER FROM POROUS MEDIA, ESPECIALLY GYPSEOUS MEDIA, FOR ISOTOPIC ANALYSIS.

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water P. H. Woods

Technical Memorandum 90/1, January 1990. 48p, 5 fig, 10 tab, 47 ref.

Descriptors: *Chemical analysis, *Distillation, *Isotope studies, *Laboratory methods, *Pore water, *Porous media, *Separation techniques, *Soil water, *Water analysis, Adsorption, Gypsum, Hexane, Kerosene.

Azeotropic distillation is a robust technique for extracting pore water from porous media for isotopic analysis. Extensive trials show that the use of toluene gives best results for water, and kerosene for non-gypseous porous media, with accuracies of about 1.5 and 0.2 per million for delta-D and delta-ISO. Extra increase at low soil water content. about 1.5 and 0.2 per million for delta-D and delta-18-O. Errors increase at low soil water contents (high matric suction). Kerosene also gives repro-ducible results for the extraction of the water of crystallization from dry gypsum. The use of hexane, with boiling time restricted to two to three hours, provides pore water from gypseous samples. The distillate is biased by about -3 and -1.1 per million with an accuracy of about 2 and 0.3 per million, for delta-D and delta-18-O. Other methods have to extract water from gypseous samples for million, for delta-D and delta-18-O. Other methods used to extract water from gypseous samples for analysis of the isotopic composition of pore water gave poor results; these were a mass balance approach, vacuum distillation at room temperature, and adsorption of equilibrated water vapor by desiccants (molecular sieve 3A, alumina and silica gel). (Author's abstract)

USE OF ELECTROMAGNETIC METHODS IN GROUND-WATER CONTAMINATION STUD-IES: AN APPLICATION AT THE SANITARY LANDFILL, FARMINGTON, CONNECTICUT. Geological Survey, Hartford, CT. Water Re-

S. J. Grady.
Connecticut Water Resources Bulletin No. 41, 1989. 58p, 30 fig, 6 tab, 28 ref.

Descriptors: *Connecticut, *Geophysical methods, *Groundwater pollution, *Path of pollutants, *Sanitary landfills, *Waste disposal, Aquifers, Conductivity, Electromagnetic waves, Groundwater quality, Resistivity.

Electromagnetic methods were used to determine the distribution and extent of groundwater contamination at a sanitary landfill in Farmington, Connecticut. Very low frequency terrain-resistivity and inductive terrain-conductivity instruments defined an electrical anomaly in the principal stratified drift aquifer at the landfill. Water quality data confirmed that the anomaly represents a plume of leachate contaminated groundwater. Apparent terrain conductivity ranged from 0.7 to parent terrain conductivity ranged from 0.7 to 8 millimhos/m in background areas to 33 millimhos/ m in the plume. Apparent terrain resisitivity ranged from 300 to 950 ohm-meters in uncontaminated areas to 16 ohm-meters in the plume. Specific

Field 7—RESOURCES DATA

Group 7B—Data Acquisition

conductance of groundwater samples from 23 wells ranged from 115 to 1,820 microsiemens/cm. conductance of groundwater sampies iron 25 wells ranged from 115 to 1,820 microsiemens/cm. High apparent terrain-conductivity zones coincide with areas of leachate-enriched groundwater with specific conductance > 1,000 microsiemens/cm. Fifteen electromagnetic surveys, utilizing the EM 168 terrain-resistivity meter and the EM 31 and EM 34-3 terrain-conductivity meters, produced similar results, were reproducible, and were each completed with 1 to 2 man days of effort. A total of 44 man days were expanded for preparation, completion, and interpretation of the electromagnetic surveys. This time compares favorably to methods traditionally employed in groundwater contamination studies. Apparent terrain-conductivity measurements carbon the specific conductance measurements. However, the specific conductance measurements had the highest correlation and indicated, for that particular instrumental configuration, that a 1.0 millimhos/m increase in the apparent terrain conductivity corresponds to a 90-microsultance of tion, that a 1.0 millimhos/m increase in the apparent terrain conductivity corresponds to a 90-microsiemens/cm increase in the specific conductance of groundwater. Electromagnetic techniques used in this study were capable of detecting the plume when the apparent terrain conductivity increased by a factor of 2.0 over average background levels and, under optimum conditions, by a factor of 1.5 over average background levels. This detection limit corresponds to an increase in specific conductance of the groundwater by about 135 microsiemens/cm over background levels. (Author's abstract)

DETERMINATION OF HYDROGEN CARBON-

DETERMINATION
ATE IN RAINWATER.
Warren Spring Lab., Stevenage (England).
For primary bibliographic entry see Field 2B.

7C. Evaluation, Processing and Publication

FACTORS CONTROLLING THROUGHFALL CHEMISTRY IN A BALSAM FIR CANOPY: A MODELING APPROACH.

New York Botanical Garden, Bronx, NY. Inst. of For primary bibliographic entry see Field 2K.
W90-06556

METHOD FOR PREDICTION OF EXTENT OF MICROBIAL POLLUTION OF SEAWATER AND CARRYING CAPACITY OF BEACHES. Bogazici Univ., Istanbul (Turkey). Dept. of Chemi-

For primary bibliographic entry see Field 5B. W90-06610

NONPOINT SOURCE POLLUTION RISK AS-SESSMENT IN A WATERSHED CONTEXT. East Carolina Univ., Greenville, NC. Dept. of Geography and Planning. For primary bibliographic entry see Field 5B. W90-06612

SEMIQUANTITATIVE X-RAY DIFFRACTION METHOD TO DETERMINE MINERAL COMPOSITION IN STREAM SEDIMENTS WITH SIMILAR MINERALOGY. Geological Survey, Reston, VA.

For primary bibliographic entry see Field 7B. W90-06625

OBJECTIVE ANALYSIS OF DAILY RAINFALL BY DISTANCE WEIGHTING SCHEMES ON A MESOSCALE GRID.

Atmospheric Environment Service, Downsview (Ontario). For primary bibliographic entry see Field 2B. W90-06655

REFINEMENT AND TESTING OF A LAKE WIND WAVE MODEL ON SEASONAL DATA. Atmospheric Environment Service, Downsview

For primary bibliographic entry see Field 2H. W90-06656

EFFECT OF PHYSICAL FACTORS ON THE VERTICAL DISTRIBUTION OF PHYTO-PLANKTON IN EUTROPHIC COASTAL WATERS.

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.

For primary bibliographic entry see Field 2L. W90-06660

CONVERSION OF THE DIGITAL LAND IN-FORMATION FILES FOR THE PURPOSE OF DRAWING RIVER BED PROFILES. Tokyo Univ. (Japan).

T. Sugitani. Chigaku Zasshi (Journal of Geography) CGZAAL, Vol. 98, No. 4, p 93-101, 1989. 5 fig, 2 tab. 9 ref.

Descriptors: *Channel morphology, *Digital map data, *Geomorphology, *Japan, *Mapping, *River beds, *Stream profiles, Data collections, Geo-graphic information systems, Rivers.

Among the Digital Land Information files orga-nized by Geographical Survey Institute, the data of river systems in Japan is supplied in three vol-umes of relational data files. A concise and practi-cal data set was made from those files for the purpose of drawing the river bed profiles. This data set is self-defined, and has the control infordata set is self-defined, and has the control infor-mation as to upstream/downstream linkage, the identifier of individual river system and the value of the pseudo-'stream order'. The generating proc-ess was performed by the 'reformer' and the 'linker'. The reformer, first reconstructed linkage data of the file through the selection of the river-mouth of the trunk. The linker framed the logical mount of the trunk. The linker framed the logical river systems by writing the pointers on each record, and masked the channels which should be ignored. Through the following passes of the linker operation, the individual river systems were identified and the stream orders' were calculated to recognize partial river systems. A sample print-out utilizing this data set is shown. (Author's abstract) W90-06661

FORMALISM FOR COMPARING RAIN ESTI-MATION DESIGNS.

Texas A and M Univ., College Station. Coll. of Geosciences.

G. R. North, and S. Nakamoto. Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 6, No. 6, p 985-992, December 1989. 7 fig. 19 ref.

Descriptors: *Data interpretation, *Estimating equations, *Experimental design, *Rain, *Rainfall rate, Estimating, Mathematical equations, Rain gages, Satellite technology, Statistical analysis.

Space-time averages of rain rates are needed in several applications. Nevertheless, they are difficult to estimate because the methods invariably leave gaps in the measurements in space or time. A formalism is developed which makes use of the frequency-wavenumber spectrum of the rain field. The mean square error of the estimate is expressed as an integral over frequency and two-dimensional wavenumber of an integrand consisting of two factors, a design-dependent-filter multiplied by the space-time spectrum of the rain rate field. Such a formalism helps to separate the design issues from the peculiarities of rain rate random fields. Two cases are worked out in detail: a low orbiting satellite which takes cell-wide snapshots at discrete intervals and a network of raingages which are gappy in space but continuous in time. (Author's detector) W90-06666

COMPARISON OF SEVERAL RADIOMETRIC METHODS OF DEDUCING PATH-INTEGRAT-ED CLOUD LIQUID WATER.
McGill Univ., Montreal (Quebec). Dept. of Meteorology. For primary bibliographic entry see Field 2B. W90-06667

ESTIMATION OF RELEASES INTO RIVERS WITH THE STEADY-STATE SURFACE WATER MODEL EXWAT USING DICHLORO-

METHANE.
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)
Projektgruppe Umweltgefaehrdungsponteniale Projektgruppe von Chemikalien. For primary bibliographic entry see Field 5B.

W90-06791

GENERATION AND PROPAGATION OF A NOCTURNAL SQUALL LINE, PART II: NUMERICAL SIMULATIONS.

National Center for Atmospheric Research, Boul-For primary bibliographic entry see Field 2B. W90-06806

REGIONAL EXCEEDANCE PROBABILITIES.
Oslo Univ. (Norway). Inst. of Geophysics. L. Gottschalk. Nordic Hydrology NOHYBB, Vol. 20, No. 4/5, p 201-241, 1989. 4 fig, 3 tab, 9 ref.

Descriptors: *Data interpretation, *Flood frequency, *Flood hydrographs, Flood forecasting, cy, *Fig.

Construction of a regional flood frequency curve is based, as a rule, on fitting this curve to representa-tive quantiles. In a regional sample of floods the tive quantiles. In a regional sample of floods the probability of extreme values corresponding to return periods, that exceed the record lengths, is much larger than that of individual series, used to determine the representative quantiles. The probabilities of exceedance of regional extremes can be calculated straightforward in case of independent data, applying the theory of order statistics. For regionally dependent data one can define an equivalent number of independent regional series and then utilize the theory for independent data. This approach is exemplified with flood data from Norway. (Author's abstract)

UNCERTAINTY IN DAM BREAK FLOW SIM-

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering. For primary bibliographic entry see Field 8B. W90-06813

ECONOMIC EFFECTS OF RIVER RECREA-TION ON LOCAL ECONOMIES. For primary bibliographic entry see Field 6B. W90-06822

SOME GENERAL RESULTS ON THE SEEP-AGE EXCLUSION PROBLEM.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Envi-ronmental Mechanics.

For primary bibliographic entry see Field 2G. W90-06846

ADVECTIVE-DISPERSIVE TRANSPORT OF DENSE ORGANIC VAPORS IN THE UNSATU-RATED ZONE, 1. MODEL DEVELOPMENT. Waterloo Univ. (Ontario). Inst. for Ground Water Research For primary bibliographic entry see Field 5B. W90-06847

ADVECTIVE-DISPERSIVE TRANSPORT OF DENSE ORGANIC VAPORS IN THE UNSATU-RATED ZONE. 2. SENSITIVITY ANALYSIS, Waterloo Univ. (Ontario). Inst. for Ground Water

For primary bibliographic entry see Field 5B.

Evaluation, Processing and Publication—Group 7C

W00.06848

COMPARISON OF REGIONAL FLOOD FRE-QUENCY ESTIMATION METHODS USING A RESAMPLING METHOD. Wisconsin Univ., Madison. Dept. of Civil and En-vironmental Engineering. For primary bibliographic entry see Field 2E. W90-06850

EFFECTS OF PARAMETER UNCERTAINTY ON LONG-TERM SIMULATIONS OF LAKE ALKALINITY.

Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 5B. W90-06855

STOCHASTIC INTERPOLATION OF RAIN-FALL DATA FROM RAIN GAGES AND RADAR USING COKRIGING: 1. DESIGN OF EXPERIMENTS.

Utah Water Research Lab., Logan. For primary bibliographic entry see Field 2B. W90-06856

DIRECT AND BOUNDARY-ONLY SOLU-TIONS OF MULTILAYER AQUIFER SYS-TEMS: PART A. STEADY STATE-SOLUTION. Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 2F.
W90-06886

STREAMFLOW MODEL USING PHYSICAL-LY-BASED INSTANTANEOUS UNIT HYDRO-

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-06889

INTEGRAL METHOD SOLUTION FOR DIF-FUSION IN A SPHERICAL BLOCK. Lawrence Berkeley Lab., CA. Earth Sciences Div. For primary bibliographic entry see Field 2F. W90-0689

USE OF TIME SERIES ANALYSIS TO DETECT CLIMATIC CHANGE. National Hydrology Research Inst., Saskatoon (Saskatchewan). Hydrometeorological Research Div.

For primary bibliographic entry see Field 2B. W90-06898

OPERATIONAL GLS MODEL FOR HYDRO-LOGIC REGRESSION. Geological Survey, Reston, VA. Water Resources

For primary bibliographic entry see Field 2E. W90-06902

COMPUTER AIDED SPILLWAY DESIGN USING THE BOUNDARY ELEMENT METHOD AND NON-LINEAR PROGRAM-

Technische Hogeschool Delft (Netherlands). For primary bibliographic entry see Field 8B. W90-06955

ASSESSMENT OF THE EFFECT OF URBAN DEVELOPMENT ON GROUNDWATER LEVELS IN A CHALK AQUIFER. University Coll., Cardiff (Wales). School of Engi-

neering. For primary bibliographic entry see Field 4C. W90-06962

HYDROGEOCHEMICAL ASSESSMENT OF GROUNDWATER QUALITY IN PARTS OF THE NIGER DELTA, NIGERIA.

Port Harcourt Univ. (Nigeria). For primary bibliographic entry see Field 2F. W90-06963

ENVIRONMENTAL INFLUENCE OF A VOL-CANIC PLUME, A NEW TECHNIQUE OF STUDY, MOUNT ETNA, SICILY. Luton Coll. of Higher Education (England). Dept.

For primary bibliographic entry see Field 5A. W90-06965

THEORETICAL ANALYSIS AND METEORO-LOGICAL INTERPRETATION OF THE ROLE OF RAINDROP SHAPE ON MICROWAVE AT-TENUATION AND PROPAGATION PHASE SHIFTS: IMPLICATION FOR THE RADAR MEASUREMENT OF RAIN.

Applied Research Corp., Landover, MD. For primary bibliographic entry see Field 7B. W90-06967

EVALUATION OF LIQUID WATER MEASUR-ING INSTRUMENTS IN COLD CLOUDS SAM-PLED DURING FIRE.

National Center for Atmospheric Research, Boulder, CO. For primary bibliographic entry see Field 2B. W90-06970

COMPARISON OF SIMULATED RAIN RATES FROM DISDROMETER DATA EMPLOYING POLARIMETRIC RADAR ALGORITHMS. National Severe Storms Lab., Norman, OK. For primary bibliographic entry see Field 2B.

DETERMINATION OF RAIN INTENSITY FROM DOPPLER SPECTRA OF VERTICALLY SCANNING RADAR.

Telecommunications Systems Group, Delft, The Netherlands. For primary bibliographic entry see Field 2B. W90-06972

INORGANIC ALUMINIUM-HYDROGEN ION RELATIONSHIPS FOR ACIDIFIED STREAMS; THE ROLE OF WATER MIXING PROCESSES. Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 5B. W90-06977

NUMERICAL STUDY OF THE WARM RAIN PROCESS IN OROGRAPHIC CLOUDS. Wyoming Univ., Laramie.
For primary bibliographic entry see Field 2B.
W90-06981

ESTIMATING THE SOIL MOISTURE RETEN-TION CHARACTERISTIC FROM TEXTURE, BULK DENSITY, AND CARBON CONTENT. Katholieke Univ. Leuven (Belgium). Lab. of Land Management. For primary bibliographic entry see Field 2G. W90-06982

EVALUATION OF SPATIAL DISTRIBUTION OF HYDRAULIC CONDUCTIVITY USING EF-FECTIVE POROSITY DATA.
Agricultural Research Service, Durant,
Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2F.

W90-06983

CORRELATION OF SPATIALLY VARIABLE SOIL WATER RETENTION FOR A SURFACE SOIL.

Louisiana State Univ., Baton Rouge. Dept. of Agronomy. For primary bibliographic entry see Field 2G. W90-06985 SUPERCOMPUTER SIMULATION OF LIQUID DROP FORMATION, FALL, AND COLLISION. Texas Univ. at Arlington. Dept. of Mathematics. For primary bibliographic entry see Field 1A.

LABORATORY AND NUMERICAL INVESTI-GATION OF SOLUTE TRANSPORT IN DIS-CONTINUOUS FRACTURE SYSTEMS. vioundland Dept. of Environment and Lands, St. John's.

For primary bibliographic entry see Field 5B. W90-07012

VOLUME ESTIMATION OF LIGHT NONA-QUEOUS PHASE LIQUIDS IN POROUS MEDIA

Kennedy/Jenks/Chilton, Inc., San Francisco, CA. For primary bibliographic entry see Field 5B W90-07014

COMPATIBLE SINGLE-PHASE/TWO-PHASE NUMERICAL MODEL: 1. MODELING THE TRANSIENT SALT-WATER/FRESHWATER INTERFACE MOTION.

Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information For primary bibliographic entry see Field 5B. W90-07017 Geologique.

ANALYSIS OF AQUIFER TESTS CONDUCTED IN FRACTURED ROCK: A REVIEW OF THE PHYSICAL BACKGROUND AND THE DESIGN OF A COMPUTER PROGRAM FOR GENER-ATING TYPE CURVES.

National Water Research Inst., Burlington (Ontar-For primary bibliographic entry see Field 2F. W90-07019

AUTOMATED ANALYSIS OF PUMPING TESTS IN UNCONFINED AQUIFERS OF SEMI-INFINITE THICKNESS.

Kuwait Inst. for Scientific Research, Safat. Water Resources Div.

For primary bibliographic entry see Field 2F. W90-07020

PROBLEMS OF SNOWMELT RUNOFF MOD-ELLING FOR A VARIETY OF PHYSIOGRA-PHIC AND CLIMATIC CONDITIONS. Geological Survey, Denver, CO. For primary bibliographic entry see Field 2E. W90-07021

WATER QUALITY MODEL FOR THE TIGRIS RIVER DOWNSTREAM OF SADAM DAM,

IRAQ. Mosul Univ. (Iraq). Saddam Dam Research Centre.

M. A. Al-Layla, and H. M. Al-Rizzo. Hydrological Sciences Journal HSJODN, Vol. 34, No. 6, p 687-704, December 1989. 14 fig, 1 tab, 19 ref, 2 append.

Descriptors: *Dam effects, *Hydrologic models, *Iraq, *Stream pollution, *Tigris River, *Water quality, *Water quality standards, Biological oxygen demand, Calibrations, Coliforms, Dissolved oxygen, Mathematical studies, Model testing, Nitrification, Phosphates, Pollutants.

A mathematical model was developed and calibrat-A mathematical model was developed and calibrated for the Tigris River downstream of Sadam Dam. The river stretch studied is 75 km long, extending from the Sadam Dam to Mosul City. The field work was conducted during the period from July to September 1986. Water samples were collected bimonthly from specified sampling points. The model simulates river assimilation canacity for a variety of water smalls to construct the contract of the contrac points. The model simulates river assimilation ca-pacity for a variety of water quality parameters by performing the numerical solution of a set of differential equations representing the aquatic system under steady state conditions. The model contains

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Group 7C—Evaluation, Processing and Publication

submodels covering the quality parameters, determination of coefficients, temperature calibration and a hydraulic submodel. In the coefficient submodel, the coefficients of BOD, DO, nitrification, phosphate and coliform bacteria are calculated and calibrated according the stream temperature by a formula that accounts for chemical reaction coefficient and a given temperature, at 20 C, and a temperature correction factor. These submodels interact together with the main model to simulate the water quality parameters of the river Tigris. To establish the validity of the model for use in the establish the validity of the model for use in the stretch of the Tigris downstream from Sadam Dam, coefficients were computed, data sets were entered and model output was obtained. The calibration process was based on the field data obtained from the survey work done in the study area. Generally, a noticeable increase in the concentrations of water quality parameters arising from water impoundment were observed. A good agreement was found between measured and simulated concentrations of water quality parameters such as phosphate, coliform bacteria, BOD, DO, and nitrification. However, discrepancies noticed during model calibration were attributed to the assumptions adopted in the model formulation, to assumptions adopted in the model formulation, to lack of field data, and to exclusion of some variables in the model building. (Friedmann-PTT) W90-07025

EFFECT OF HYDROMETEOROLOGICAL FACTORS ON SPREADING OF OIL PROD-UCTS IN RESERVOIRS.

For primary bibliographic entry see Field 5B. W90-07045

MATHEMATICAL MODEL OF THE DAM-FOUNDATION' STATIC SYSTEM OF THE KHUDONI HYDROELECTRIC STATION. For primary bibliographic entry see Field 8E. W90-07046

TURBULENCE MEASUREMENTS IN MODEL SETTLING TANK

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hy-For primary bibliographic entry see Field 8B. W90-07064 dromechanik

FIELD PREDICTABILITY OF FLUME AND WEIR OPERATING CONDITIONS. Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.

For primary bibliographic entry see Field 8B. W90-07070

TRANSMISSION LOSSES IN ARID REGION. Dames and Moore, Sarasota, FL. For primary bibliographic entry see Field 2E. W90-07072

EFFICIENT HORIZONTAL TWO-DIMEN-SIONAL HYDRODYNAMIC MODEL. William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.

Coastal Engineering COENDE, Vol. 14, No. 1, p 1-18, February 1990. 9 fig, 1 tab, 25 ref.

Descriptors: *Estuaries, *Hydrodynamics, *James River, *Mathematical models, *Model studies, *Tidal currents, Accelerated flow, Atmospheric pressure, Coriolis force, Friction, Tidal force, Wind stress.

An efficient numerical model is applied to estimate the detailed tidal-current fields in the middle reach of the James River near Hog Point, Virginia. This model uses an economic full implicit finite-difference scheme and variable grid size to solve the depth-averaged equations of motion and the continuity equation. Terms of atmospheric pressure gradient, wind stresses, tidal force, bottom and lateral friction, Coriolis force and convective acceleration are all included. Thus this model can be used to simulate tidal circulation, storm surge, and shear induced flow. A variable grid system was used to

give better resolution at specified subareas. The governing equations and numerical scheme are relatively simple, and it can be easily maintained and adopted for other applications. The computing time of this model is approximately linear proportional to the number of fluid cells. This model can be run on a personal computer with sufficient efficiency. (Author's abstract)

NEED FOR COMPUTER-ASSISTED HYDROG-

RAPHY. E and S Computer Systems, Inc., Sparta, NJ. D. Dykstra.
Public Works PUWOAH, Vol. 121, No. 2, p 43-44, February 1990. 1 fig.

Descriptors: *Computer programs, *Computer-aided design, *Hydrography, *Land development, *Runoff forecasting, *Stream discharge, Water law, Water resources development.

The use of computers and software geared towards hydrography has only become common during the last five years. Computer-assisted hydrography is becoming a necessity because of the ever-increasing emphasis placed by local, county, state and national governments on improved water resource development. Computer assistance is useful in four types of hydrographical analysis: performing runoff calculations for the 1-year, 2-year, 5-year, 10-year, 30-year, and 100-year storms; designing systems for the retention and detention of water runoff destined to leave a development site; creating documentation support, using water profiling. runoff destined to leave a development site; creating documentation support, using water profiling, for obtaining stream encroachment permits; and compiling an equal conveyance chart for land fill in a property's 100-year storm floodline. The software's ability to perform complicated computations and to eliminate errors makes computer-assisted hydrography an essential part of hydrographical engineering. (Brunone-PTT) W90-07103

ESTIMATING UNSATURATED HYDRAULIC CONDUCTIVITY FROM EASILY MEASURED SOIL PROPERTIES.

Katholieke Univ. Leuven (Belgium). Lab. for Land Management. For primary bibliographic entry see Field 2G. W90-07106

TRANSPORT OF NONSORBED CHEMICALS IN THE SUBSURFACE ENVIRONMENT: PRO-POSED MODEL WITH EXPERIMENTAL VER-IFICATION.

Southern Univ., Baton Rouge, LA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-07108

MODELING COASTAL LANDSCAPE DYNAM-

Maryland Univ., Solomons. Chesapeake Biological For primary bibliographic entry see Field 4C. W90-07136

MODELLING ECOLOGICAL IMPACTS OF THE ACIDIFICATION OF WELSH STREAMS: TEMPORAL CHANGES IN THE OCCUR-RENCE OF MACROFLORA AND MACROIN-

VERTEBRATES.
University Coll., Cardiff (Wales). Dept. of Applied

Biology, N. S. Weatherley, and S. J. Ormerod. N. S. Weatherley, and S. J. Ormerod. Hydrobiologia HYDRB8, Vol. 185, No. 2, p 163-174, November 1989. 7 fig, 2 tab, 33 ref.

Descriptors: *Acid rain effects, *Acid streams, *Acidification, *Computer models, *Forecasting, *Macroinvertebrates, *Macrophytes, *Model studies, *Streams, Acid deposition, Acid water, Coniferous forests, Ecological effects, Flora, Hardness, Hydrochemical models, Hydrogen ion concentration, Moorland, Population dynamics.

Models are developed which predict changes in macrofloral and macroinvertebrate assemblages in

response to surface water acidification. Empirical response to surface water administration. Empirical relationships between assemblage type and water chemistry are used to predict the probabilities of species occurrences during acidification, as recreated by the hydrochemical model, MAGIC. The water chemistry of two streams is simulated between 1844 and 2124. From 1958, alternative between 1844 and 2124. From 1958, alternative scenarios involved either moorland or conifer forest. From 1984, sulfate deposition was either constant or reduced by 50%. Alternative ecological models driven by pH or total hardness are compared. The floral model showed minor differences between scenarios, probabilities of species occurrence changing gradually and reaching stable values by around 1964. For certain invertebrate species the occurrence probabilities changed rapidly over relatively short periods, for example in the late 20th century under moorland with constant deposition. Reduced sulfate deposition prevented decrease of acid sensitive species in moorland scedeposition. Reduced sulfate deposition prevented decrease of acid sensitive species in moorland scenarios but not under forest, which greatly accelerated faunal changes irrespective of deposition patern. Differences between the pH and hardness models indicated that the effects of these parameters should be separated in future studies. Where an earlier model showed only step changes in invertebrate assemblage type, this new approach can model more precise taxonomic shifts occurring with acidification. Such changes could be important to conservation, or as early indicators of response to pollution. The tentative simulations here suggest that large taxonomic changes may occur over relatively short periods during acidification. (Author's abstract) W90-07156

ORGANIZATIONAL AND TECHNOLOGICAL MODELING OF WORKS AT CONSTRUCTION SITES WITH THE USE OF PERSONAL COM-

PUI Bass.
V. B. Zadorov, and A. M. Nikol'skii.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 309-311, 1990. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 8-10, June, 1989.

Descriptors: *Computer-aided design, *Computers, *Construction methods, *Management planning, *Soviet Union, Computer models, Construc-

The conversion of the construction industry to operation under new management conditions, the realization of planning the activities of construction organizations with consideration of standard construction times and determination of completed construction times and determination of completed technological stages and complexes of works are imposing increased requirements on the organizational and technical preparation of construction works. With the appearance of computer centers and automated management services, many of the functions of organizational and technological preparation have been transferred to them. It was hoped that with computers the problems of organizational and technical modeling underlying calendar planning would become central in automated dar planning would become central in automated management systems. However, the transfer of numerous functions characteristic only of construction organizations to computer centers led to a break in the technological chain of the develop-ment of organizational and technical models of ment of organizational and technical models of constructing objects. The engineer lost the possi-bility of tracing the entire path of model develop-ment and intervened in the process of modeling at each of its steps, which led to the creation of unrealistic and ineffective models. Development of universal software in a convenient form is essential. universal software in a convenient form is essential. At present, a broadened variant of computer-based systems is being developed, in which there are additional possibilities with respect to a more convenient formation of an alternative network model in a conversational mode, and provision of an automatic regime of aggregation and disaggregation of models. (Mertz-PTT) W90-07164

EVALUATION OF THE EFFECT OF BANK STORAGE ON THE HYDROPOWER INDICES OF A HYDROELECTRIC STATION.

For primary bibliographic entry see Field 2E.

Evaluation, Processing and Publication—Group 7C

NEW METHOD OF QUANTITATIVELY DE-SCRIBING DRAINAGE AREAS,

Uppsala Univ. (Sweden). Dept. of Hydrology. L. Hakanson, T. Andersson, and A. Nilsson. Environmental Geology and Water Sciences EGWSEI, Vol. 15, No. 1, p 61-69, January/February 1990. 10 fig, 6 tab, 19 ref.

Descriptors: *Drainage area, *Geomorphology, *Lakes, *Mapping, Bedrock, Mercury, Quantitative analysis, Soil types.

A new method was introduced, the DAZ (drainage area zonation) method, to quantify environmental parameters, such as bedrocks, soil type, and land drainage areas. The work was carried out within the framework of the Swedish project 'Liming-mercury.' Two important points in the project are that there are quantifiable relationships between the character of the drainage area and the lake and that several limnological and morphometric parameters may have an impact on the mercury content in fish. The DAZ method accounts for the fact that, for example, a certain soil type does not have an even distribution in the whole drainage area. To get a simple yet relevant measure of the influence of, for example, soil type on the lake character, the drainage areas were divided into zones using a special transparent paper placed on the map. The method gives normalized values depending on: (1) the distance between the object and given lake, (2) the main direction of water flow in the drainage area, and (3) the area of the environmental parameter (e.g., area of bedrock). In the DAZ method, dot counting is used for determination of area. The dot-counting method was compared with other methods for area determination (planimeter and square counting). Dot counting is the fastest and square counting the most time compared with other methods for area determina-tion (planimeter and square counting). Dot count-ing is the fastest and square counting the most time consuming. The statistical reliabilities of the dot method and the planimeter were compared. The planimeter is best for large homogeneous objects. Dot counting is very well suited for heterogeneous objects. The statistical certainty of area determina-tion depends on size, heterogeneity, and form of the objects, as well as the time dedicated to the determination. A nomogram is also given, which illustrates the relationships between the number of counts, i.e., the number of times the transparent olotted paper is put on the map and the dots counted, the error in the area determination, and the statistical reliability. (Author's abstract)

ASSESSMENT OF NUTRIENT EFFECTS AND NUTRIENT LIMITATION IN LAKE OKEE-

CHOBEE. Florida Univ., Gainesville. Dept. of Fisheries and

Aquaculture.
For primary bibliographic entry see Field 5C.
W90-07202

MODELING WATER UTILIZATION IN LARGE-SCALE IRRIGATION SYSTEMS: A QUALITATIVE RESPONSE APPROACH. Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics. For primary bibliographic entry see Field 3F. W90-07209

APPLICATION OF BIOASSAYS IN THE RESOLUTION OF ENVIRONMENTAL PROBLEMS; PAST, PRESENT, AND FUTURE.
Sheffield Univ. (England). Dept. of Animal and

Plant Sciences

For primary bibliographic entry see Field 5A. W90-07253

ACCURACY AND INTERPRETATION OF GROWTH CURVES OF PLANKTONIC ALGAE. Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W90-07264

HYPOTHESIS FORMULATION AND TEST-ING IN AQUATIC BIOASSAYS: A DETERMI-NISTIC MODEL APPROACH.

Lakehead Univ., Thunder Bay (Ontario). Dept. of

Biology.
For primary bibliographic entry see Field 5A.
W90-07300

ASSESSING THE IMPACT OF EPISODIC POL-

Water Research Centre, Medmenham (England). Medmenham Lab. For primary bibliographic entry see Field 5C. W90-07310

CONDITIONAL STABILITY CONSTANTS AND BINDING CAPACITIES FOR COPPER (II) BY ULTRAFILIERABLE MATERIAL ISOLATED FROM SIX SURFACE WATERS OF WYO-

MING, USA.
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife. eries and Wildlife.
For primary bibliographic entry see Field 5B.
W90-07313

PUMP TEST ANALYSIS OF CONFINED AOUI-

FER.
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W90-07322

FINITE DIFFERENCE SOLUTION OF BOUS-SINESQ UNSTEADY-STATE EQUATION FOR HIGHLY SLOPING LANDS,

Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Irrigation and Drainage Engineering. For primary bibliographic entry see Field 2F. W90-07323

MODELLING INTERCOMPARTMENT TRANSFER OF POLLUTANTS: THE CASE OF

LEAD. Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Bilthoven (Netherlands). For primary bibliographic entry see Field 5B. W90-07339

CLASS OF TIME SERIES URBAN WATER DEMAND MODELS WITH NONLINEAR CLI-

Tennessee Univ., Knoxville. Energy, Environment and Resources Center. For primary bibliographic entry see Field 6D. W90-07347

SIMULATION OF BIODEGRADABLE ORGAN-IC CONTAMINANTS IN GROUNDWATER: 1. NUMERICAL FORMULATION OF PRINCIPAL DIRECTIONS. Waterloo Univ. (Ontario). Inst. for Ground Water

Research. For primary bibliographic entry see Field 5B. W90-07351

SIMULATION OF BIODEGRADABLE ORGAN-IC CONTAMINANTS IN GROUNDWATER: 2, PLUME BEHAVIOR IN UNIFORM AND RANDOM FLOW FIELDS, Waterloo Univ. (Ontario). Inst. for Ground Water

Research.

For primary bibliographic entry see Field 5B. W90-07352

CONTINUOUS-TIME INVERSE OPERATOR FOR GROUNDWATER AND CONTAMINANT TRANSPORT MODELING: DETERMINISTIC CASE

Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-07353

ANALYTICAL SOLUTION TO RICHARDS' EQUATION FOR A DRAINING SOIL PRO-

Arizona Univ., Tucson. Dept. of Soil and Water Science.
For primary bibliographic entry see Field 2G. W90-07354

LABORATORY VERIFICATION OF THE RE-SIDUAL FLOW PROCEDURE FOR THREE-DI-MENSIONAL FREE SURFACE FLOW. Fluor Daniel, Inc., Irvine, CA. For primary bibliographic entry see Field 2F. W90-07355

ANALYSIS OF SOLUTE REDISTRIBUTION IN A HETEROGENEOUS FIELD.

Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition. For primary bibliographic entry see Field 5B. W90-07356

EFFICIENT NUMERICAL METHODS FOR IN-FILTRATION USING RICHARDS' EQUATION. Commonwealth Scientific and Industrial Research Organization, Townsville (Australia). Div. of Soils. For primary bibliographic entry see Field 2G. W90-07357

HYDRAULIC CONDUCTIVITY AND UNFROZEN WATER CONTENT OF AIR-FREE ZEN WATER FROZEN SILT.

Cold Regions Research and Engineering Lab., Hanover, NH. For primary bibliographic entry see Field 2C. W90-07360

COLD WATER INJECTION INTO SINGLE-AND TWO-PHASE GEOTHERMAL RESER-VOIRS.

S-Cubed, La Jolla, CA. For primary bibliographic entry see Field 2F. W90-07361

FIRST- AND THIRD-TYPE BOUNDARY CON-DITIONS IN TWO-DIMENSIONAL SOLUTE TRANSPORT MODELING.

International Technology Corp., Monroeville, PA. For primary bibliographic entry see Field 5B. W90-07362

NEW COUPLING TERM FOR DUAL-POROSI-

TY MODELS.
Sandia National Labs., Albuquerque, NM. Fluid and Thermal Sciences Dept. For primary bibliographic entry see Field 2F. W90-07363

NITROGEN ANALYSES IN EUTROPHIC AL-KALINE AND PEATY WATERS: A COMPARI-SON OF DIFFERENT METHODS TO ANA-LYSE AMMONIA-NITROGEN.

Limnologisch Inst., Oosterzee (Netherlands). Tjeu-

For primary bibliographic entry see Field 7B. W90-07424

GROUND-WATER MONITORING COMPLIANCE PROJECTS FOR HANFORD SITE FACILITIES: PROGRESS REPORT FOR THE PERIOD JANUARY 1 TO MARCH 31, 1988. VOLUME 3: APPENDIX A (CONTD).

Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 5A. W90-07476

GROUND-WATER MONITORING COMPLIANCE PROJECTS FOR HANFORD SITE FACILITIES: PROGRESS REPORT FOR THE PERIOD JANUARY 1 TO MARCH 31, 1988. VOLUME 2: APPENDIX A.

Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 5A. W90-07477

Group 7C-Evaluation, Processing and Publication

HISTORICAL ARCHAEOLOGY OF DAM CON-STRUCTION CAMPS IN CENTRAL ARIZONA. VOLUME 3: LABORATORY METHODS AND DATABASE COMPUTERIZATION. Bureau of Reclamation, Phoenix, AZ. For primary bibliographic entry see Field 6G.

For primary W90-07480

SHORT-TERM METHODS FOR ESTIMATING THE CHRONIC TOXICITY OF EFFLUENTS AND RECEIVING WATERS TO MARINE AND ESTUARINE ORGANISMS. ENVIOUNTE UNIONISMS.
Environmental Protection Agency, Cincinnati,
OH. Office of Research and Development.
For primary bibliographic entry see Field 5C.
W99-07505

8. ENGINEERING WORKS

8A. Structures

BRAZIL'S BALBINA DAM: ENVIRONMENT VERSUS THE LEGACY OF THE PHARAOHS

VERSUS THE LEGACY OF THE PHARAORS IN AMAZONIA.

Instituto Nacional de Pesquisas da Amazonia,
Manaus (Brazil). Dept. of Ecology.

For primary bibliographic entry see Field 6G.
W90-06607

RELIABILITY CONCEPTS IN RESERVOIR

DESTUN.

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.

E. J. Plate.

Nordic Hydrology NOHYBB, Vol. 20, No. 4/5, p 231-248, 1989. 6 fig, 15 ref.

Descriptors: *Dam failure, *Reservoir design, *Reservoirs, Dam design, Dam stability, Irrigation reservoirs, Model studies, Operational failure, Overtopping.

The case of a dam for an irrigation reservoir is used as an example to illustrate the different modes of failure of a water resources system. The types of failure to which a dam can be subjected are described in terms of a framework of general reliability analysis. Two applications are considered: the case of operational failure, illustrated by means of an irrigation reservoir for arid countries, and the case of dam failure due to overtopping. Conceptual models are given which permit the inclusion of reliability and other figures of merit into both operation and safety analysis. (Author's abstract) W90-06812

HYDROLOGICAL AND HYDRAULIC INVES-TIGATIONS OF CLOSURE OF THE ANGARA RIVER AT THE SITE OF THE BOGUCHANY

RIVER AT THE SITE OF THE BUGUCHANT HYDROELECTRIC STATION. V. S. Pantaleev, and A. V. Shlychkov. Hydrotechnical Construction HYCOAR, Vol. 23, No. 5, p 24:247, 1990. 5 fig. 6 tab. Translated from Gidrotekhnicheskoe Stroitel

Descriptors: *Dam construction, *Hydraulic engineering, *USSR, Angara River, Boguchany Hydroelectric Station, Cofferdams, Dams, Hydrolo-

Closure of the Angara River at the site of the Boguchany hydroelectric station on 25 October 1987 was the largest such closure accomplished using the two-embankment scheme. Final closing of the 14-m upstream gap damming the Angara of the 14-m upstream gap damming the Angara took 1 hr 10 min. With a total discharge of 2440 cu took I ar 10 min. with a total discharge of 2440 cu m/sec, a discharge of 360 cu m/sec passed through the gap by the start of the period. The final fall was 2.7 m. By the end of the closing, the embank-ments had advanced into the channel to a considerable distance from the longitudinal cofferdams and the flow passed as a narrow band between the gaps. Damming of the Angara at this site occurred gaps. Damming of the Angara at this since occurred under complex hydrometeorological conditions (frosts and a shuga and ice run). These conditions made stream gaging complicated. In particular, it was impossible to measure the discharges and observations of the water level also were difficult. The results obtained here were sufficient, however, to be generalized as to possible use of the same materials for the closing of other river channels. (Rochester-PTT)

SELECTION OF THE LAYOUT OF THE POW-ERHOUSE OF A PUMPED-STORAGE STA-TION IN A DROP SHAFT. For primary bibliographic entry see Field 8C. W90-06863

PROPERTIES OF ASPHALTIC CONCRETE OF DIAPHRAGMS AND FACINGS OF ROCKFILL

For primary bibliographic entry see Field 8F. W90-06865

EXPERIENCE IN USING DETRITAL DOLO-EXPERIENCE IN USING DETRITAL DOLO-MITES FOR CONSTRUCTING EARTH DAMS. N. F. Aripov, G. N. Petrov, and A. N. Skibin. Hydrotechnical Construction HYCOAR, Vol. 23, No. 5, p 268-272, 1990. 4 fig. 1 tab. Translated from Gidrotechnicheskoe Stroitel'stvo, No. 5, pp. 30-33, May, 1989

Descriptors: *Dam construction, *Dolomite, *Earth dams, *Euphrates River, *Iraq, *Rock properties, Al-Hadithah Hydro Development, Economic aspects, Engineering geology, Paraffinization, Particle size.

The dam of the Al-Hadithah (Al-Qadisiyah) hydro The dam of the Al-Hadithah (Al-Qadisiyah) hydro development is being constructed on the Euphrates River. In the area there is an unlimited supply of intensely leached, partially ferruginate coarse and fine detrital farinaceous dolomites. Almost no examples exist of using dolomites for dam construction. In construction of the Al-Hadithah dam, the following requirements are being imposed on the dolomite material in the dam: average density not less than 1770 kg/cu m, strength indices (tan = 0.6 for C = 0), and permeability coefficient 1 micron/sec. Because of the uniqueness of this dam, the sec. Because of the uniqueness of this dam, the volume of dolomite fill to be used (15 million cu volume of dolomite ful to be used (15 million cu m), and the limited information on dolomite as a dam material, extensive laboratory and field inves-tigations were conducted during design and con-struction. The aggregate structure is the most im-portant feature of dolomite affecting all its properportant feature of dolomite affecting all its properties. Particle-size distribution depends more on the technology of the works preparing it than it does on dolomite's geologic properties. Minor changes in processing procedures can change the composition and properties of dolomite. The farinaceous dolomites used in the Al-Hadithah dam are hard rock not excavatable mechanically, but after loosening by blasting and wetting they become a rubbly material having both internal friction and cohesion. The material can be rolled only at an optimal moisture content. Under construction conditions the most effective means for destroying the aggregate structure of dolomites are additional excavation in the quarry and rolling by vibrating aggregate structure of dolomites are additional excavation in the quarry and rolling by vibrating sheepsfoot rollers. Subsequent compaction is best achieved by powerful vibrating rollers with smooth rolls. Temperature has a considerable effect on the compaction characteristics of dolomite and the labor required for this task. At air temperatures of 45-55 C, the expenditures of labor on compacting dolomite increase 1.5-2.0 times. The paraffinization method is best for checking the density of soils similar to weathered dolomites. (Rochester-PTT) W90-06866

DESIGNING SAFETY INTO DAMS.

Gibb (Alexander) and Partners, London (Eng-P. A. A. Back.
International Water Power and Dam Construction
IWPCDM, Vol. 42, No. 2, p 11-12, February 1990.

Descriptors: *Civil engineering, *Dam stability, *Dams, Design criteria, Management planning, Safety, Sri Lanka.

The criteria governing the design of dams frequently can be very imprecise. For example,

design flood estimates may be inaccurate by factors as high as 4 or 5, and foundation conditions may not be well known despite extensive geologic stud-ies. Dam safety must be the dominant consideries. Dam safety must be the dominant consideration in dam design, and must take into account all factors that can be reasonably identified. The safety of dams depends on three main factors: design, quality of construction, and operation and maintenance. Design approaches are often too narrow, putting undue reliance on numbers generated by computers based on assumptions that were quite crude. It seems better to adopt a broad approach, to accept the fact that many assumptions, such a foundation medius may be inaccurate or proach, to accept the fact that many assumptions, such a foundation modulus, may be inaccurate or completely wrong. The analysis should look at a spectrum of moduli, not just one value. Wherever possible, there should be at least two lines of defense. Redundancy should be designed into the structure. This often can be achieved at very little extra cost. In foundation design it is important to differentiate between stabilizing conditions that differentiate between stabilizing conditions that act in parallel or in series. For example, passive resistance due to downstream mass and shear resistance at the concrete-rock interface both act to hold a at the concrete-rock interface both act to hold a dam block in place, but the passive resistance only takes effect after shear resistance has been overcome. Thus, these factors do not act in parallel to restrain the dam block. Too much dependence should not be placed on highly elaborate mechanical devices (e.g., gates) or on computerized control equipment, for the safety of a dam. This is particularly the control of the co equipment, for the safety of a dam. Inis is particularly relevant in developing countries. A gate has been designed that opens without fail at the right time, by the right amount, and without operator intervention or electric power to the gate. This gate is currently installed in two places: Victoria and Samanalewewa dams, Sri Lanka. There are three areas of management activity that relate to refer to world. Incident contents to the content of the cont safety as well: design review, construction supervision, and maintenance and operation, including continued inspection and consultation by the project consultants after the dam is operational. (Rochester-PTT) W90-06871

REDUCING UPLIFT PRESSURES IN CONCRETE GRAVITY DAMS.

Colorado Univ., Boulder. Dept. of Civil Engineering.

Amadei, T. Illangasekare, C. Chinnaswamy, and D. I. Morris.

International Water Power and Dam Construction IWPCDM, Vol. 42, No. 2, p 13-17, February 1990. 7 fig, 3 ref. Electric Power Research Institute Contract RP2917-07.

Descriptors: *Concrete dams, *Dam stability, *Hydraulic design, *Maximum probable floods, *Uplift pressure, Computer models, Cracks, Design criteria, Drains, Mathematical models.

Recent action by the U.S. Congress mandated that dams be required to withstand the probable maximum flood without failure. Almost 100% of the dams built before 1975 could not remain stable at dams built before 1975 could not remain state at this increased flood load and, theoretically, would fail. Research studies are being conducted in re-sponse to the new regulations with the aim of modeling the uplift pressure distribution in actual and postulated cracks in dam concrete, including the effects of drains when present. Both analytical the effects of drains when present. Both analytical and numerical approaches as well as laboratory and field testing are included in these Electric Power Research Institute-sponsored studies. The stability analysis of an existing concrete gravity dam with cracks in it requires that uplift forces and resulting moments caused by water pressures in the cracks be quantified. No previous studies have been able to quantify drain effectiveness and predict pressure distributions in cracks in concrete. Computer models developed as part of the present Computer models developed as part of the present studies now accomplish this task. Analytical and numerical models can be used to conduct parametric studies of factors that affect crack pressure distribution and drain effectiveness. These are of distribution and drain effectiveness. These are of two types: (1) crack properties (e.g., roughness, aperture, tapering, and geometry) and (2) drain properties (e.g., diameter, position, and surface properties). The computational models can handle a variety of crack flow conditions that are most likely to occur in the field, including steady-state

Structures-Group 8A

flow under normal dam operation and transient conditions during floods and unusually high water conditions. Although most of the flow is laminar (in cracks of < 1 mm aperture), turbulent flow is possible around the drains where high-head gradipossible around the trains where high-nead gradi-ents exist. The accuracy of the computational models in predicting crack uplift pressure and drain effectiveness has been demonstrated using a large physical model of a crack in concrete in the laboratory. Verification studies for the steady-state part of the flow are completed and are in progress for transient flow conditions. (Rochester-PTT)

SOME CONSIDERATIONS OF THE DURABIL-

COBA S.A., Lisbon (Portugal).

A. da Silveira. International Water Power and Dam Construction IWPCDM, Vol. 42, No. 2, p 19-28, February 1990. 8 fig. 10 tab, 8 ref.

Descriptors: *Dam failure, *Dam stability, *Deterioration, Comparison studies, Concrete dams, Earth dams, Embankments, International Commission on Large Dams, Statistics.

A statistical analysis prepared by the International Commission on Large Dams (ICOLD)'s Commit-tee on Deterioration of Dams and Reservoirs has been conducted to investigate types of deteriora-tion, including failures, and their relationship to the most significant parameters and causes. The results of this analysis are presented here, including and overview of the risks of deterioration of various overview of the risks of deterioration of various types of dam and appurtenant structures. Of all the cases of deteriorated dams, the percentage of concrete and masonry dams (40%) is higher than that of existing dams of this type (32.5%), whereas the opposite is true for embankment dams (60% vs 67.5%, respectively), demonstrating that concrete and masonry dams are more deterioration-prone. Nevertheless, the consequences of deterioration of concrete and masonry dams has been less serious, concrete and masonry dams has been less serious, as shown by their respective percentages of failures (23% vs 77%). The largest percentage of deteriorated concrete dams corresponds to dams completed between 1920 and 1939 (14.3%), whereas the largest percentage of deteriorated embankment dams corresponds to those concluded between 1960 and 1975 (25.4%). However, most tween 1960 and 1975 (23.4%). However, most concrete and masonry dams were completed in the period 1940-1959, whereas most embankment dams were completed in 1960-1975. The percentage of failures in concrete and masonry dams completed between 1960 and 1975 is very low; for embankment dams the percentage is low compared to the number of dams constructed. Failures have tended number of dams constructed. Failures have tended to occur at first filling for concrete and masonry dams and after 5 yr of operation for embankment dams. The situation regarding detection methods is not satisfactory. Direct observation sometimes only enables deterioration to be detected when it has reached a stage when failure is already unavoidable. Remedial measures include: improving facing tendingues for concrete and masonry dams. avoitable. Remedia measures include: improving facing techniques for concrete and masonry dams, improving drainage, better management of the reservoir and downstream zones, and repair of surfaces in contact with the flow. (Rochester-PTT) W90-06873

LESSONS FROM THE TUCURUI EXPERI-

Monosowski Associate Consultants, SIC Ltd. Sao Paulo, Brazil

For primary bibliographic entry see Field 6G. W90-06874

LARGE DAMS: IMPLICATIONS OF IMMOR-Leyland Consultants Ltd., Auckland (New Zealand).

B. Leyland. International Water Power and Dam Construction IWPCDM, Vol. 42, No. 2, p 34-37, February 1990.

Descriptors: *Dams, *Management planning, Decommissioning, Economic aspects, Large dams, Long-term analysis.

Large dams are built to extremely high standards of safety to withstand most natural disasters. They typically have a design economic life span of 50 or more years, but may remain in service long after their investment costs have been recovered, question rarely considered, however, is the por question rarely considered, however, is the possi-ble need to decommission large dams long after their economic life has passed. Many possible alter-natives, such as continuously maintaining and oc-casionally rehabilitating the dam and appurtenant structures, draining the reservoir, or destroying the structures, training the reservoir, or destroying the dam with explosives, are either not possible at all or entail tremendous expense that was not provid-ed for in the original economic analysis. Several serious problems are associated with dam removal, for example, what is to be done about the silt released, whether the low-level outlet (if present) is adequate and can in fact be used to dewater the reservoir and pass flood flows into the future, and reservoir and pass 1100d flows into the future, and what will happen if spillways are used continuous-ly (after hydrostation abandonment) rather than only during flood periods. Other problems concern only during flood periods. Other problems concern how to remove turbines and other equipment permanently embedded in concrete and how long concrete and geomembranes can be expected to last in terms of very long periods (e.g., 500-1000 yr). Large dams should either be designed for an indefinite life span or decommissioning and dismantling needs should be considered in the initial design. (Rochester-PTT) W90-06875

FIELD GUIDE TO WATER WELLS AND BOR-

Water Research Centre, Medmenham (England). L. Clark.

Geological Society of London Professional Hand-book. Halsted Press, New York, New York. 1988. 155 p. 45 ref.

Descriptors: *Boreholes, *Drilling, *Sampling, *Well construction, *Wells, Construction methods, Design standards, Geohydrology, Groundwater mining, Pumping tests, Well pumping.

This book is a practical guide to the work involved in drilling boreholes and wells. The book is not a driller's manual; it is intended for people who design and supervise the drilling activities. The correct design of boreholes and wells in relation to their geohydrological setting is considered fundamental to any groundwater investigation and therefore well design and construction are dealt with in some detail. The emphasis in groundwater projects has changed to some extent from the settent f with in some detail. The emphasis in groundwater projects has changed to some extent from resources to pollution studies, and so attention is also given to the sampling techniques used with drilling. Pumping test analysis is covered in detail in other texts, so that only the basis of pump testing of wells is considered here. A full reference list gives the reader guidance to those texts useful in the field, for design specifications and for general background reading. (Lantz-PTT)

FLEXIBLE STRUCTURES: MANUAL ON DESIGN. REFERENCE

MANUAL ON DESIGN.

B. I. Sergeev, and L. O. Timblin.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-169916.
Price codes: A06 in paper copy, A01 in microfiche.
109p, 33 fig. 5 tab, 38 ref.

Descriptors: *Dam design, *Flexiblity, *Flexible structures, *Materials engineering, *Membranes, *Plastics, Baffles, Cofferdams, Dams, Diversion dams, Hydraulic structures, Soil stabilization.

This report covers one of several joint studies carried out as part of a U.S./Joint Working Group on Plastic Films and Soil Stabilizers in the Field of Plastics in Hydrotechnical Construction. The joint studies were done in the period 1975-1982. This report covers the design concepts for the use of flexible membranes for flexible and inflatable structures such as cofferdams, diversion dams, baffle walls, and drop structures. A Russian-English glossary for this subject is included as an appendix. (Lantz-PTT) W90-06947

COMPUTER AIDED SPILLWAY DESIGN USING THE BOUNDARY ELEMENT METHOD AND NON-LINEAR PROGRAM-

Technische Hogeschool Delft (Netherlands). For primary bibliographic entry see Field 8B. W90-06955

DETERMINATION OF THE PARAMETERS OF A FOUNDATION MODEL FROM ENGI-NEERING-GEOLOGICAL SURVEY DATA. For primary bibliographic entry see Field 8E. W90-07042

MATHEMATICAL MODEL OF THE 'DAM-FOUNDATION' STATIC SYSTEM OF THE KHUDONI HYDROELECTRIC STATION. For primary bibliographic entry see Field 8E. W90-07046

EFFICIENCY OF CONSTRUCTING HYDRO-ELECTRIC STATIONS AND EXPERIENCE OF OPERATING THE SAYANO-SHUSHENSKOE HYDROPOWER COMPLEX.

For primary bibliographic entry see Field 8C. W90-07162

USE OF THE ENERGY OF SMALL RIVERS AND IRRIGATION SYSTEMS IN THE KIRGIZ

Y. P. Belyakov, A. G. Zyryanov, and M. S.

Sulaimanov. Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 304-308, 1990. 2 fig, 3 tab, 6 ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 4-7, June, 1989.

Descriptors: *Electric potential, *Energy sources, *Hydroelectric power, *River basin development, *River basins, *USSR, Canals, Electric power, Energy, Linear calculation method, Reservoirs,

The drainage system in the Kirgiz SSR, when estimating energy resources possible for use at small hydrostations, can be divided into small rivers, reservoirs, and irrigation canals. The richest in energy resources are the small rivers of mountain regions, which are characterized by steep drops and rapid currents. The main indices characterizing the energy value of mountain rivers are the normal annual discharge, coefficient of variation, type of feeding, longitudinal slope, and unit power. 134 rivers with average annual discharges from 0.3 to 50 cu m/sec and a length of more than 10 km were selected for calculating the potential energy resources of small streams. The potential energy resources of the selected rivers were calculated by the linear calculation method. In a territorial aspect all small rivers were grouped into eight isolated basins of the rivers Ak-Sai, Naryn, Sary-Dahza, Kara Darya, Syr Darya, Chu, Talas, and lake Issyk-Kul. The total potential energy resources of the small rivers concentrated in these basins were determined to be 8,214,820 kilowatts. basins were determined to be 8,214,820 kilowatts with respect to power and 71,934 kilowatt hours with respect to energy production. It is concluded that Kirgizia has a dense network of small rivers, reservoirs and irrigation canals, providing enough natural resource, and economic factors to make it possible to launch the construction of small hyof the economic potential of the entire drainage system and development of schemes of using the energy of the area's water resources merit further investigation. (Mertz-PTT)

ORGANIZATIONAL AND TECHNOLOGICAL MODELING OF WORKS AT CONSTRUCTION SITES WITH THE USE OF PERSONAL COM-PUTTERS

For primary bibliographic entry see Field 7C. W90-07164

Field 8—ENGINEERING WORKS

Group 8A-Structures

STATE OF THE CONTACT OF CONCRETE WITH ROCK UNDER THE UPSTREAM FACES OF DAMS.

For primary bibliographic entry see Field 8F. W90-07169

SUBSTANTIATION OF LAND PROTECTION IN THE LOWER POOLS OF HYDROELECTRIC STATIONS.

For primary bibliographic entry see Field 8C. W90-07171

CONDITIONS OF CONVERTING A HYDRO-ELECTRIC STATION WITH HORIZONTAL BULB UNITS TO A HYDROELECTRIC STA-TION-PUMPED-STORAGE STATION

For primary bibliographic entry see Field 8C. W90-07172

MODERNIZATION OF THE HYDROME-CHANICAL EQUIPMENT OF THE CHIRKEY HYDROELECTRIC STATION. For primary bibliographic entry see Field 8C. W90-07173

KINEMATIC CHARACTERISTICS OF FLOWS IN TRANSITION SECTIONS OF UNLINED CANALS.

For primary bibliographic entry see Field 8B. W90-07174

ARCH DAM RESPONSE TO NONUNIFORM SEISMIC INPUT.
Colorado State Univ., Fort Collins. Dept. of Civil

Engineering.
P. S. Nowak, and J. F. Hall.
Journal of Engineering

Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 1, p 125-139, 1990. 6 fig, 2 tab, 25 ref. NSF grant CES-8619908.

Descriptors: *Arch dams, *Dam stability, *Earth-quake engineering, *Engineering geology, *Seis-nic properties, Dam foundations, Earth-quakes, Finite element method, Frequency-domain analy-

A frequency-domain investigation into the effects of nonuniform earthquake excitation on the response of a three-dimensional arch dam-water-foundation system was performed. First, the free-field motions of the canyon walls were obtained by the boundary element method after making some simplifying assumptions about the canyon geometry and the earthquake mechanism. In the second part of the analysis, the frequency-domain response of the dam-water-foundation system was computed of the dam-water-foundation system was computed by the finite element method using the previously determined free-field excitations. To more concisedetermined free-field excitations. To more concisely quantify the effect of uniform seismic input, the frequency-domain responses were converted into the time domain in the form of standard deviations of the response to a random input with an earth-quake-like frequency content. As shown by an analysis of Pacoima Dam, inclusion of nonuniformity in the stream component of the excitation reduces the dam response, and the effect of nonuniformity in the cross-stream and vertical components varied, with the potential for a significant increase. (Author's abstract)

CASE STUDY OF A LABYRINTH WEIR SPILL WAY.

Alberta Environment, Edmonton. Development

and Operations Div.
F. G. Tacail, B. Evans, and A. Babb.
Canadian Journal of Civil Engineering CJCEB8,
Vol. 17, No. 1, p 1-7, February 1990. 6 fig. 2 tab, 7

Descriptors: *Hydraulic design, *Labyrinth weirs, *Spillways, *Weirs, Alberta, Case studies, Flow discharge, Hydraulic models, Performance evalua-tion, South Heart Dam.

A labyrinth weir is an effective and economical means of providing increased spillway capacity

under some restricted operating conditions. This type of weir is particularly suited to reservoir sites where a low head to high discharge relation is required; the topography restricts the spillway width, and a self-operating structure is highly desirable for emergency operation. Polisitism with the control of the property of the control of the con sirable for emergency operation. Definitive guide-lines and theoretical procedures pertaining to hydraulic design of this type of weir are not completely established. This paper describes the design and hydraulic model study conducted for a labyand hydraulic model study conducted for a laby-rinth weir arrangement proposed for the South Heart Dam in northern Alberta. The elevation-discharge relationships obtained from the hydrau-lic model studies showed that, for the same spill-way width, the two-cycle weir is superior to the way width, the two-cycle weir is superior to the three-cycle labyrinth weir that was considered initially. Infinite variations of the weir geometry are possible and the difference in discharge relationship between generalized curves and the site-specific scale model proved the importance of hydraulic model studies. In the case of the South Heart Dam labyrinth spillway, the cost of the model studies to verify the hydraulics was minor compared to the estimated construction costs. (Author's abstract) W90-07233

CONSTRUCTION OF THE IONA OUTFALL SUBMARINE SECTION.

Dillingham Construction Ltd., North Vancouver (British Columbia).

T. W. Lively, C. D. Gowe, and H. R. Woodhead.
Canadian Journal of Civil Engineering CICEB8, Vol. 17, No. 1, p 113-118, February 1990. 9 fig.

Descriptors: *Construction, *Construction methods, *Outfall, *Outfall sewers, Construction materials, Equipment, Hydraulic structures.

In February 1987, the Greater Vancouver Sewerage and Drainage District awarded an \$8.5 million contract for the construction of the Iona Outfall submarine section. The contract awarded involved the installation of approximately 3200 m of twin 2.3 m diameter steel outfall, of which 500 m was twin 2.1, 1.8, and 1.4 m diameter steel diffuser twin 2.1, 1.5, and 1.4 in chamber steer influser sections. The outfall extended from the end of the Iona Jetty into the Strait of Georgia near the mouth of the Fraser River and was 107 in deep at the end of the diffuser. The tender documents suggested a method of installation such that the suggested a method of installation such that the entire twin outfall pipe was fabricated on an exis-ing jetty complete with flotation pipe and pulled into the water. The contractor submitted an alterinto the water. The contractor submitted an atter-native method with the tender and was the suc-cessful low bidder. The proposed installation method was to assemble the pipe into nominal 300 m lengths, launch them, tow them to the site, and sink and bolt them together underwater. The project was substantially completed by November 1987, about 8 months after the contract was award-1987, about 8 months after the contract was awarded. The contractor used several innovative construction methods during its execution. Five significant innovations were: (1) A material handling system was developed composed of pipe cradles and beds to effectively move and protect the easily damaged pipe sections during the cladding and welding operations; (2) A clamshell dredging program was used where conditions suggested a hydraulic dredging program was the logical choice; (3) A high production welding system was developed using an internal line up clamp with copper backup ring; (4) The contractor used a unique method of transporting and lowering the pipe strings on site which has not been used before; and (5) The contractor developed the 'big bolting tool', a purpose-built, sophisticated tool incorporating advanced robotic systems. With better visibility, this tool would be able to connect pipes under water without diver assistance. (Author's abstract) W90-07237 W90-07237

GUIDELINES FOR REHABILITATION OF DRAINLINES CROSSED BY PIPELINES,

DRAINLINES. CROSSED BY PIPELINES. American Society of Civil Engineers, New York. Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 123-131, January/February 1990. 4 fig.

Descriptors: *Design criteria, *Drainage engineering, *Pipelines, *Standards, Construction methods, Regulations. Subsoil drainage.

Guidelines are presented that are designed to aid in the correct and successful crossing of drainline systems intersected by pipeline construction. Al-though specific procedures to maintain require drainage service and to rehabilitate disturbed drainage systems have been used in specific pipedrainage systems have been used in specific pipe-line construction situations, no general guidelines or criteria have been developed to integrate the expertise of the pipeline and drainage disciplines for the design, construction, maintenance, and op-eration of the two systems. The present guidelines attempt to address the concerns of the drain system owner and pipeline contractors and accommodate pipeline construction while maintaining the integri-ty of the drainage system. Several aspects of the problem must be addressed whenever drainlines are to be crossed: specifications required under Federal safety regulations. temporary repairs to Federal safety regulations, temporary repairs to interrupted drainlines, identifying drainline location, maintaining drain flows during construction, drain rehabilitation alternatives (realignment along original position or construction of a new alignment), drain rehabilitation procedures (grade and alignment requirements, construction techniques), sequencing of work, and construction inspection. Successful rehabilitation of drainlines will provide drains that function in a manner at least equal to the drains prior to pipeline construction. (Roches-W90-07325

STUDIES ON MSF DESALINATION-PROCESS DESIGN, CONSTRUCTION AND START-UP OF A PROTOTYPE MSF PLANT IN INDIA. Bhabba Atomic Research Centre, Bombay (India). Desalination Div

For primary bibliographic entry see Field 3A. W90-07454

DESIGN AND COST ESTIMATES FOR A CON-NECTING CHANNEL BETWEEN EAST DEVILS LAKE AND WEST STUMP LAKE, DEVILS LAKE BASIN, NORTH DAKOTA.

Barr Engineering Co., Minneapolis, MN.
Available from the National Technical Information Avanable from the National Technical information Service, Springfield, VA. 22161, as AD-A205-638. Price codes: A10 in paper copy, A01 in microfiche. Report prepared for U.S. Army Corps of Engi-neer, St Paul Dist., MN, March 1896. 265p, 3 tab, 11 plates, 12 ref, 4 append

Descriptors: *Channels, *Construction costs, *Cost analysis, *Design standards, *East Devils Lake, *West Stump Lake, Canal construction.

The water surface elevations of the Devils Lake chain of lakes have been rising over the past sever-al decades. Several alternatives are being consid-ered to alleviate the rising lake levels which are ered to alleviate the rising lake levels which are approaching levels where potential for significant damage to adjacent property exists. A connecting channel approximately 10 miles long from East Devils Lake to West Stump Lake, which is an important segment of several different alternatives for an outlet channel for the Devils Lake chain of for an outlet channel for the Devils Lake chain of lakes, is the subject of this report. Preliminary designs for thirteen alternative connecting channel cases have been developed. Cases 1A, 1B, 1C, and 2G are gravity flow from East Devils Lake to West Stump Lake. Cases 2P, 3A, 3C, 4L, 4H, 5A, 5B and 5C require a pump station to lift the water from East Devils Lake to the upstream end of the channel where flow will be gravity to West Stump Lake. Seven of the cases have a design discharge capacity of 200 cu ft/sec, three have a design capacity of 600 cu ft/sec, and three have a design capacity of 1,000 cu ft/sec, and three have a design capacity of 1,000 cu ft/sec, and three have a design capacity of 1,000 cu ft/sec, and three have a design capacity of 500 cu ft/sec, and three have a design capacity of 1,000 cu ft/sec, and three have a design capacity of 1,000 cu ft/sec, and three have a design capacity of 1,000 cu ft/sec, and three have a design capacity of 1,000 cu ft/sec. These preliminary decapacity of 1,000 cu ft/sec, and three make a sagar-capacity of 1,000 cu ft/sec. These preliminary de-signs are the basis for the generation of cost esti-mates for each of the thirteen cases. The cost estimates include all capital costs for construction of the connecting channel, except that easement and right-of-way acquisition costs are not included. The estimated capital costs range from \$3,920,000 for 2G to \$14,500,000 for 3C. (Lantz-PTT)

8B. Hydraulics

UNCERTAINTY IN DAM BREAK FLOW SIM-ULATION.

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering.

Or Water Resources Engineering. C. S. Kung. Nordic Hydrology NOHYBB, Vol. 20, No. 4/5, p 249-256, 1989. 5 fig, 8 ref.

Descriptors: *Dam failure, *Dam stability, *Flow characteristics, *Flow models, Discharge, Hydro-graphs, Mannings coefficient, Roughness coeffi-cient, Simulation analysis, St Venant equation.

The flow caused by a dam breaking across its entire length can be approximated by a one-dimensional, unsteady flow model in the form of the St. Venant equations. In this model, the flow is governed by the river geometry and the river roughness, which is quantified by Manning's coefficient. The roughness characteristics are generally difficult to estimate under natural conditions. Thus, the estimates of the Manning's coefficient will in general be subject to uncertainty. The uncertainty in the discharge and depth hydrographs due to the uncertainty in estimating the roughness characteristics of a river was investigated. A specific case of the Noppikoski Dam in Sweden that failed in 1985 was used to illustrate the sensitivity of the flow simulation on the roughness coefficient. The analysimulation on the roughness coefficient. The analy-sis shows that the uncertainty in the dam break sis shows that the uncertainty in the dam oreas flow simulation due to the uncertainty in estimating Manning's coefficient, is significant. The uncertainty is larger at greater distances from the dam, and is greater for the discharge hydrograph than for the depth hydrograph. (Author's abstract) W90-06813

PROPOSED SWEDISH SPILLWAY DESIGN FOODS IN RELATION TO OBSERVATIONS AND FREQUENCY ANALYSIS. Sveriges Meteorologiska och Hydrologiska Inst.,

Svenges McCoulogassa von Aryston Norrkoeping. S. Bergstrom, G. Lindstrom, and H. Sanner. Nordic Hydrology NOHYBB, Vol. 20, No. 4/5, p 277-292, 1989. 10 fig, 4 tab, 11 ref.

Descriptors: *Design floods, *Flood flow, *Flood forecasting, *Flood profiles, *Sweden, Flood frequency, Rainfall, Seasonal variation, Snowmelt,

Proposed guidelines for the computation of spill-way design floods in Sweden are described. The guidelines are based on the transformation of extreme hydrological conditions to floods by use of conceptual hydrological models. Floods computed according to the guidelines are compared to observations for both autumn conditions when rainfall dominates and for snowmelt conditions with rainfall dominates and for snowmelt conditions in spring. The highest floods are in the order of 60% of the proposed guidelines. Comparisons with frequency analysis show that the computed floods are well beyond the 10,000 year flood according to the Gumbel and Lognormal 2 distribution functions, while the results according to Lognormal 3 are more uncertain. (Author's abstract)

PROPOSED SWEDISH SPILLWAY DESIGN GUIDELINES COMPARED WITH HISTORI-CAL FLOOD MARKS AT LAKE SILJAN.

Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping. J. Harlin

Nordic Hydrology NOHYBB, Vol. 20, No. 4/5, p 293-304, 1989. 8 fig, 19 ref.

Descriptors: *Design floods, *Flood flow, *Flood forecasting, *Flood frequency, *Flood profiles, *Sweden, Comparison studies, Flood hazard, Historical floods, Lake Siljan, Model studies, Stand-

A comparison between the proposed Swedish spill-way design floods and historic flood marks made at lake Siljan in central Sweden, is shown. Fre-quency analysis is performed incorporating pregage information on water levels together with a

sensitivity analysis of modeling assumptions. A water level of 0.42 to 0.75 meters above the highest historic flood mark (166.10 meters in the year 1659) was obtained when routing the design spring flood through lake Siljan. The design autumn flood lifted the lake to 1.56 to 1.52 meters below the highest flood mark. Return period for the design spring and autumn flood was estimated to about opining and autumn flood was estimated to about 1,000 years. The uncertainty in frequency analysis proved to have larger impact than modeling assumptions on estimating the risk of the design flood. (Author's abstract) W90-06816

EXACT INTEGRAL SOLUTIONS FOR TWO-PHASE FLOW.

Colorado State Univ., Fort Collins. Dept. of Agri-cultural and Chemical Engineering. For primary bibliographic entry see Field 5B. W90-06849

ANALYSIS OF ONE-DIMENSIONAL SOLUTE TRANSPORT THROUGH POROUS MEDIA WITH SPATIALLY VARIABLE RETARDA-TION FACTOR.

Stanford Univ., CA. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W90-06852

MODELING FRACTURE FLOW WITH A STO-CHASTIC DISCRETE FRACTURE NETWORK: CALIBRATION AND VALIDATION: 1. THE FLOW MODEL

Food Nationale Superieure des Mines de Paris, Fontainebleau (France). For primary bibliographic entry see Field 2F. W90-06857

MODELING FRACTURE FLOW WITH A STO-CHASTIC DISCRETE FRACTURE NETWORK: CALIBRATION AND VALIDATION: 2. THE TRANSPORT MODEL.

Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). For primary bibliographic entry see Field 2F.

DETERMINING THE MEAN DEPTH OF OVERLAND FLOW IN FIELD STUDIES OF FLOW HYDRAULICS.
State Univ. of New York at Buffalo. Dept. of

Geography. For primary bibliographic entry see Field 2E. W90-06859

HYDROLOGICAL AND HYDRAULIC INVESTIGATIONS OF CLOSURE OF THE ANGARA RIVER AT THE SITE OF THE BOGUCHANY HYDROELECTRIC STATION, For primary bibliographic entry see Field 8A. W90-06862

LOCATION OF TRASH RACKS ON UNDER-GROUND PRESSURE CONDUITS OF HYDRO-

For primary bibliographic entry see Field 8C. W90-06868

ANALYSIS OF THE RELATIONSHIP FOR DETERMINING THE BED LOAD IN SAND CHANNELS.

For primary bibliographic entry see Field 2J. W90-06869

EFFECT OF A FREE SURFACE ON THE FOR-MATION OF A WAVE BED OF A CHANNEL

For primary bibliographic entry see Field 2J. W90-06870

ONE-DIMENSIONAL FLOW OVER A PLANE: CRITERIA FOR KINEMATIC WAVE MODEL-

Department of Scientific and Industrial Research, Christchurch (New Zealand). Hydrology Centre. For primary bibliographic entry see Field 2E. W90-06885

OPTIMAL PUMPING POLICY AND GROUND-WATER BALANCE FOR THE BLUE LAKE AQ-UIFER, CALIFORNIA, INVOLVING NONLIN-EAR GROUNDWATER HYDRAULICS. Indian Inst. of Tech., Bombay. Dept. of Civil

Engineering.
For primary bibliographic entry see Field 4B.
W90-06893

COMPUTER AIDED SPILLWAY DESIGN USING THE BOUNDARY ELEMENT METHOD AND NON-LINEAR PROGRAM-MING.

MING.
Technische Hogeschool Delft (Netherlands).
H. C. Henderson, M. Kok, and W. L. DeKoning.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB89-170948.
Price codes: E03 in paper copy, A01 in microfiche.
Report No. 88-59, 1988. 36p, 9 fig, 2 tab, 28 ref.

Descriptors: *Computer models, *Computer-aided design, *Model studies, *Nonlinear programming, *Spillways, Computer programs, Dam design, Design standards.

A two-dimensional model is formulated for determining the free surface and the discharge for a stationary incompressible, homogeneous, non-viscous and irrotational flow over a fixed spillway. The flow satisfies the LaPlace equation and the Bernoulli equation (potential flow). An important feature of the model is that it can be extended to design the spillway structure when the spillway is not fixed but the pressure on the spillway is described by a cavitation criterion. The continuous model is discretized by the boundary element method (BEM). A non-linear programming algorithm is used to calculate the pressures and the shape of the spillway. A computer-aided design package is developed on a PC, using the equations describing the free surface, the BEM, and standard optimization techniques. The input and output of the model are realized using graphical routines. Additionally the convergence and the computation time of the algorithms are discussed. (Author's abstract) abstract) W90-06955

EVALUATION OF METHODS FOR DETER-MINING THE VERTICAL DISTRIBUTION OF HYDRAULIC CONDUCTIVITY.

Nevada Univ. System, Reno. Desert Research Inst. For primary bibliographic entry see Field 7B. W90-07018

ANALYTIC METHOD OF HYDRAULIC CAL-CULATION OF EDDY SHAFT SPILLWAYS, V. V. Volshanik, A. L. Zuikov, and A. P.

Mordasov. ical Construction HYCOAR, Vol. 23, Hydrotech No. 4, p 214-220, 1990. 3 fig, 2 tab, 18 ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 38-43, April, 1989.

Descriptors: *Analytical methods, *Flow equa-tions, *Hydraulic design, *Mathematical analysis, *Spillways, Eddies, Hydraulic engineering, Hy-draulic geometry, Hydraulic structures.

Several methods of hydraulic calculation of eddy shaft spillways have been developed. A proposed analytic method has been developed and compared with known ones and with the results of experimental investigations. The analytic methods investigated are based on laws of conservation and, unlike earlier known methods, take into account not only the size and shape of the water passage-way but also contraction of the flow upon entering the spiral chamber from the inlet channel or conduit, hydraulic losses of energy at the entry to the vertical shaft, and the presence here of a zone of equalization of flow. In calculating the characteris-

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tics of swirled flow over the vertical shaft height, its potential energy related to the effect of centrifugal body forces is taken into account. The investigated methods make it possible to obtain calculated values of hydraulic characteristics of eddy shaft spillways and functions of the variation of swirled flows in vertical shafts most closely coinciding with experimental data. Deviations between experimental dataletics is within measurements and escuption. nd calculation lie within measurement accument and calculation lie within measurement accuracy. This permits recommending the given methods for practical use when designing eddy shaft spillways and for predicting and analyzing their operation. (VerNooy-PTT) W90-07047

HYDRAULIC RESISTANCES OF DEFORMA-BLE CHANNELS AND THEIR STABILITY

N. Bekimbetov.

N. d. p. 220-224, 1990. 2 fig, 6 ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 43-45,

Descriptors: *Channel erosion, *Channel morphology, *Channel stability, *Erosion, *Flow friction, *Hydraulic roughness. *Stability analysis, Channel ogy, *Channel stability, *Erosion, *Flow friction, *Hydraulic roughness. *Stability analysis, Channel flow, Channels, Deposition, Flow velocity, Mathematical models, Sediment-water interfaces, Turbulent flow, Vertical distribution.

The resistance of a channel, in addition to granular The resistance of a channel, in addition to granular roughness of the channel surface and channel forms (waves and ripples), is determined by the intensity of flow turbulence and expenditure of part of the turbulent energy on suspension and transport of sediments. In the case when more sediments enter the canal than it can transport, of the avess lead occurs and all asperideposition of the excess load occurs and all asperideposition of the excess rous occurs aim an asperi-ties of channel roughness are equalized by sedi-ment deposition. Since a change in the velocity field of flow is accompanied by a change in rough-ness of the channel, i.e., in the size and shape of the waves or migrating bottom relief, parameters for the distribution of velocities measured in large canals in the lower reaches of the Amu Darya (Soviet Union) were used. Distribution of the mean vertical velocities of flow was studied at selected stretches of canal. Formulas of the velocity distribution and mean velocity deficits on the vertical velocity deficit were used for obtaining the theo-retically substantiated formula of channel resist-ance. Mathematical equations were developed to determine stability criteria for deformable channels. Using morphometric relations developed for large canals, parameters of stable channels can be determined, using the established flow turbulence and friction velocity corresponding to the start of movement of soil particles composing the channel bed. (VerNooy-PTT)

ESSENCE OF THE COEFFICIENT OF EFFEC-

ESSENCE OF THE COEFFICIENT OF EFFEC-TIVE UPLIFT AREA. V. V. Tetel'min, and V. A. Ulyashinskii. Hydrotechnical Construction HYCOAR, Vol. 23, No. 4, p 234-240, 1990. 3 fig, 3 tab, 6 ref. Translat-ed from Gidroteknicheskoe Stroitel'stvo, No. 4, p 53-58, April, 1989.

Descriptors: *Building codes, *Dam foundations, *Design criteria, *Structural settlement, *Uplift pressure, Dam design, Mathematical analysis, Permeability, Rock properties, Sayano-Shushenskoe Dam, Seepage, Water pressure.

According to the Soviet building code SNiP II-54-77, in calculations of the foundations of dams, the water pressure on the foundation in the upper and lower pools should be taken with a factor incorporating the coefficient of effective uplift area. An examination was made of the coefficient of effective uplift area, as it relates to dam foundations. Calculations on the foundation of the Sayano-Shushenskoe dam were used as an example. It was necessary to distinguish the coefficient of effective area of action of the seeping water and coefficient of spatial work of the permeable foundation, because one is a unique geometric characteristic and the other is an energy characteristic of the flow region of the rock mass. When determining the

settlements of the foundation and structure during their monitoring, absolute settlements for the fun-damental bench marks of the geodetic network had to be considered. Values of the coefficient of spatial work of the permeable rock mass of the foun-dation and bank can be determined by measuring the relative settlements of the territory adjacent to the female settlements of the territory adjacent to the dam, the outer monitored boundary of which is 2 to 3 kilometers from the Sayano-Shushenskoe dam. Values of the coefficient of spatial work of the foundation, determined from observations of settlements of territory adjacent to the dam, agree with official recommendations. However, in consideration of the great importance of the accuracy sideration of the great importance of the accuracy of determining surface and seepage forces for ensuring the reliability of a planned structure, it is advisable to supplement the relevant article of the SNiP building code with a more distinct regulation with respect to determination and assignment of the coefficient of spatial work of the permeable foundation. (VerNooy-PTT) W90-07050

TURBULENCE MEASUREMENTS IN MODEL SETTLING TANK.

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.

dromechanik.
D. A. Lyn, and W. Rodi.
Journal of Hydraulic Engineering (ASCE)
JHEND8, Vol. 116, No. 1, p 3-21, January 1990. 12 fig, 2 tab, 16 ref.

Descriptors: *Flow characteristics, *Flow pattern, *Fluid mechanics, *Hydraulic models, *Hydraulics, *Settling tanks, *Turbulent flow, Eddies, Flow system, Hydraulic properties, Inflow, Inlets.

Turbulence measurements were made in the inlet region of a rectangular laboratory settling tank with a two-component laser-Doppler system. The flow fields from a plane jet impinging on two types of deflector, at constant depth and discharge, were studied. Effect due to density differences or the received of settlinger, were not considered. presence of sediment were not considered. Al-though the two flow fields exhibited marked difference in terms of the extent of their recirculation regions and the extent of regions of high turbulent transport, flow-through curves from tracer tests indicated little difference. A comparison to the case without deflector showed improved hydraulic efficiency, attributable to the inhibition of short-circuiting effects or to increased initial mixing. Strong and complex three-dimensional effects were found. Of the three cases, the use of the two-sided found. Of the three cases, the use of the two-sided deflector produced the shortest inlet region, approximately half as large as in the other two cases, and therefore achieved the fastest approach to the ideal of plug flow. The inlet zone of the one-sided deflector was somewhat shorter, about 80-90%, than that without deflector. The flow-through curves for the cases with deflector showed significant improvement in hydraulic efficiency over that without deflector. Three-dimensional effects were, surprisingly, stronger than would be expected from surprisingly, stronger than would be expected from simple sidewall effects, and exhibited a complex simple sidewall effects, and exhibited a complex vertical as well as complex plan structure. If the three-dimensional flow patterns observed were due less to the sidewalls and more to the separation phenomenon, then, it is concluded, such patterns could also arise in circular tanks. A good prediction of the flow-through curves does not necessarily imply, or even require, a good prediction of the flow field, as the curves may be quite insensitive to flow details. However, it seems unlikely that a generally applicable predictor of the curves, which generally applicable predictor of the curves, which can be used without special calibration, can be developed without also being a good predictor of the flow field. (Friedmann-PTT) W90-07064

VELOCITY OF PARTICLES FALLING IN VER-TICALLY OSCILLATING FLOW.
Delaware Univ., Lewes. Air-Sea Interaction Lab. For primary bibliographic entry see Field 2J. W90-07065

HYPERCONCENTRATED SAND-WATER MIX-TURE FLOWS OVER FLAT BED. Waterloopkundig Lab. te Delft (Netherlands). For primary bibliographic entry see Field 21.

W90.07066

FLOW NEAR SLOPED BANK IN CURVED CHANNEL.

Alberta Univ., Edmonton. Dept. of Civil Engi-For primary bibliographic entry see Field 2E. W90-07067

2-D DEPTH-AVERAGED FLOW COMPUTA-TION NEAR GROYNE.

ASIAN INSTANCE OF Tech., Bangkok (Thailand). Div. of Water Resources Engineering.

T. Tingsanchali, and S. Maheswaran.
Journal of Hydraulic Engineering (ASCE)
JHENDS, Vol. 116, No. 1, p 71-86, January 1990.
9 fig, 2 tab, 20 ref.

Descriptors: *Channel flow, *Flow around objects, *Flow velocity, *Groins, *Hydraulic models, *Shear drag, *Shear stress, *Streamflow, *Turbulent flow, Mathematical studies, Model studies, Numerical analysis.

The depth-averaged velocity and bottom shear stress distributions in a rectangular channel near a groyne (groin) were computed by using a 2-D depth averaged model. The model uses a hybrid finite difference scheme and an iterative method to solve the governing equations of flow and turbulence transport. Due to streamline curvature effects in the region near the groyne tip, a correction factor was incorporated into the turbulence model that significantly improved the agreement between the computed and experimental data of the velocities and of the streamline pattern compared to previous numerical methods. In this region, the bottom shear stress was found to be largely influenced by the 3-D effects. A 3-D correction factor was introduced which considerably improved the computed bottom shear stresses. Sensitivity analysis was made on the model coefficients and on the sis was made on the model coefficients and on the correction factors of the streamline curvature and the 3-D effects. A comparison between computed results and experimental data is presented for streamline pattern, velocity profiles, shear stress distribution, and influence of constriction ratio on recirculation. Agreements were found to be satisfactory for all of these factors. (Friedmann-PTT) W90-07068

HYDRAULIC DESIGN OF ERODIBLE-BED CHANNELS.

San Diego State Univ., CA. Dept. of Civil Engineering. H. H. Chang.

Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 1, p 87-101, January 1990. 12 fig, 1 tab, 8 ref.

Descriptors: *Bank protection, *Channel erosion, *Channelization, *Flood channels, *Flood control, *Hydraulic design, *Hydraulic properties, Bank erosion, Fluvial sediments, Sediment discharge, Sediment transport, Sediment yield.

Bank protection is often employed to stabilize and alluvial channel and to reclaim land from a flood plain. For the sake of channel-bed stability, the plain. For the sake of channel-bed stability, the hydraulic geometry of the channel must be designed so that its sediment-transport capacity matches the supply from the upstream natural reach. Construction of a flood-control channel in a flood plain usually increases the flow velocity and sediment transport. To maintain an approximate sediment transport. To maintain an approximate sediment equilibrium, the slope of the channelized reach is reduced using drop structures. The channelized reach and the natural reach have dissimilar geometries; their sediment-transport rates are usually different under the changing discharge, and the channel as designed will undergo scour and fill during the design-flood event. To account for the time-dependent processes and general channel ge-ometry, a mathematical model for water and sedi-ment routing is used to determine the hydraulic geometry of erodible-bed channels. The simulated sediment yield and its spatial variation are em-ployed to arrive at the equilibrium (nonscouring and nonsilting) geometry at the peak discharge.

Hydraulics-Group 8B

Sediment transport and fluvial processes were also modeled to determine the depth of toe entrenchment. The toe profile showed a toe-down depth of ft just above a drop structure, which gradually increases upstream to 10 ft just below the next drop structure. The toe elevations extend below the corresponding design-bed elevations by the toe-down depths. The toe-down depth includes the court induced by any longituding sediment imbaltoe-down depths. The toe-down depth includes the socur induced by any longitudinal sediment imbal-ance, scour associated with the channel curvature in a bend, and one-half of the antidune height. The toe entrenchment for erodible-bed channels is an important factor in the project cost. The design for channel stability generally reduces the toe-down requirement. Drop structures limit channel-bed fluctuation, thereby reducing the toe-down depth. (Friedmann-PTT)

FIELD PREDICTABILITY OF FLUME AND WEIR OPERATING CONDITIONS. Agricultural Research Service, Phoenix, AZ. Water Conservation Lab. For primary bibliographic entry see Field 8B. W90-07070

FIELD PREDICTABILITY OF FLUME AND WEIR OPERATING CONDITIONS.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, J. A. Replogle, and Y. Reinink.
Journal of Hydraulic Engineering (ASCE)
JHENDS, Vol. 116, No. 1, p. 102-118, January
1990. 16 fig, 1 tab, 8 ref.

Descriptors: *Dam design, *Head flumes, *Head loss, *Hydraulic design, *Hydraulic models, *Hydraulic properties, *Model studies, *Weirs, Discharge capacity, Flumes, Hydraulic structures, Laboratories, Mathematical studies.

Laboratory studies were conducted on a rectangular broad-crested weir to determine the effects of entrance and exit conditions on the discharge and entrance and exit conditions on the discharge and required energy loss. In doing so, a method for visually determining whether downstream conditions affect the flume calibration was developed. The current mathematical model of these flumes satisfactorily predicts both discharge and required head losses. Approach-ramp slopes of 3:1 and 2:1 are shown to be acceptable for accurate discharge prediction, although a slight rounding of the approach ramp corners will improve predictions. At high ratios of energy, head to throat length and with a sudden downstream transition, the model slightly underpredicted the required energy loss. As long as the water surface profile is dropping continuously from the approach ramp to the end of the throat, the downstream water level is not influencing discharge prediction. Field observations encing discharge prediction. Field observations and measurements supported these laboratory results, which should apply to most long-throated flumes, since a rectangular broad-crested weir represents the worst-case conditions for head losses. (Author's abstract) W90-07070

DEVELOPMENT AND INTRODUCTION OF THE OHTPI-2 OPTIMAL HYDRAULIC TRANSPORT PERFORMANCE INDICATOR. N. K. CAPACHVIKOV, C. I. Kiselev, G. Y. speranskii, and G. D. Temnikov. Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 312-318, 1990. 5 fig. 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 10-15, 1992. 1998.

Descriptors: *Energy, *Hydraulic transportation, *Pipelines, *Suluries, *Soil properties, *Soils, *Soviet Union, Dredging, Hydraulics, Monitoring,

Among the main factors influencing the cost effectiveness of pipeline transport of soil are the selection and maintenance of the optimal parameters of hydraulic transport-the consistency of the slurry and its speed corresponding to minimum energy expenditures. Experimental investigations being carried out since the early 1950s established that a partially silted regime, when the transport speed is

close to the critical, corresponds to the minimum close to the critical, corresponds to the minimum specific expenditures of energy on hydraulic trans-port of soil. These completely objective recom-mendations are not used in practice owing to the absence of monitoring means enabling a determina-tion under field conditions of the sediment layer in the pipeline and the consistency of the seument layer in the pipeline and the consistency of the slurry. A device for monitoring the sediment layer in a pipe-line has been devised and an optimal hydraulic transport performance indicator based on the conductometric method has been developed. The in-stallation of the monitoring device on a dredge makes it possible for the operator to maintain optimal saturation of the operator to maintain optimal saturation of the mixture with soil for given conditions. An increase of productivity and reduced energy expenditures of 18% were achieved during the test. By means of the indicator it is during the test. By means of the indicator it is possible to check the existing parameters of hydraulic transport-head, flow rate, and diameter of the pipeline and their correspondence to the particular soil conditions. The indicator can also be used for monitoring soil level and liquid phase in a vessel. (Mertz-PTT) W90-07165

KINEMATIC CHARACTERISTICS OF FLOWS IN TRANSITION SECTIONS OF UNLINED CANALS.

V. I. Elimov, and E. K. Rabkova.

Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 356-359, 1990. 5 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 43-45,

Descriptors: *Canal design, *Canals, *Hydraulics, *Soviet Union, Channel flow, Flow, Flow control, Flow measurement, Hydraulic design, Kinematic

To join two different cross sections of an unlined To join two different cross sections of an unlined canal running lengthwise in soils differing in particle-size distribution, it is necessary to provide a transition section of variable cross section (narrowing or expanding in plan). To study the character of flow in nonprismatic channels and to develop practical recommendations on the design of canals with transitions, a detailed study of the kinematic structure of the flow on transitions under laborate structure of the flow on transitions under laboratory conditions was undertaken. The laboratory investigations were conducted in a 25 by 1.4 by 0.5vestigations were conducted in a 25 by 1.4 by 0.5-m channel flume with a circulating water supply. In the case of a nonprismatic cross section of a canal the form of the free surface is determined by the slope of the bottom of the transition, and the rate of contraction or expansion of channel affects mainly the steepness of the particular type of curve of the free surface of the flow, as well as its dimensions along the length of the canal. In the case of a canal transition from narrow and shallow to wider and deeper there are extremely unfavorable hydraulic conditions of the flow on the transition and in the downstream stretch of the canal. able hydraulic conditions of the flow on the transition and in the downstream stretch of the canal. On transitions with an adverse slope of the bottom, the length of the transition is determined by the angle of expansion of its sides. On transitions with a sustaining slope of the bottom. In the case of joining canals with a transition gradually expanding in plan and an adverse slope of the bottom, an angle of expansion of the sides of 4-6 degrees is recommended. In the case of joining canals with a transition gradually narrowing in plan and a sustaining slope of the bottom, the necessary length of the transition is determined by the ratio of the widths of the upstream and downnecessary length of the transition is determined by the ratio of the widths of the upstream and down-stream stretches of the canal, as well as by the difference in the maximum depths of these sec-tions. It is recommended to design transitions within stronger soils. (Mertz-PTT) W90-07174

SPLIT-STEP FOURIER ALGORITHM FOR

Delaware Univ., Newark. Ocean Engineering Pro-L. C. Munasinghe, and R. A. Dalrymple.

Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 2, p 251-267, 1990. 5 fig,

Descriptors: *Algorithms, *Fourier analysis, *Model studies, *Wave propagation, *Waves, Diffraction, Ocean waves, Shoals, Wave refraction.

A parabolic model for propagation of water waves, implemented with an efficient split-step Fourier transform algorithm, is presented. The algorithm, widely used in acoustics to solve the parabolic form of the Helmholtz equation and modified to approximately account for wave number dependency in the direction of propagation, was successfully applied to model refraction and diffraction of water waves. The solution algorithm is exact for a constant depth ocean and gives a good approximation for a wave spectrum on a uniform slope. The results of the model for an elliptical shoal on a uniform slope are presented for both linear and nonlinear wave dispersion relationships and show good agreement with experimental results. The wide-angle capabilities of the model cross section on a flat bottom. The algorithm is very efficient and stable, permitting large computational step sizes in the direction of propagation. (Author's abstract) W90-07200

FLOW IN SPILLWAYS WITH GRADUALLY VARIED CURVATURE.

Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
X. Q. Xu, and X. X. Sun.

Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 2, p 390-398, 1990. 3 fig,

Descriptors: *Flow characteristics, *Gradually-varied flow, *Hydraulic geometry, *Spillways, Cavitation, Finite element method, Hydraulic engi-neering, Pressure distribution.

neering, Pressure distribution.

In the conventional design of a spillway invert and flow bucket, circular, elliptic, and parabolic curves are generally used to connect straight boundaries. Because of the abrupt change in curvature at tangency points, considerable drop of pressure may occur, which sometimes causes cavitation damage. Two kinds of curves with gradually varied curvature, CGVC 1 and CGVC 2, are suggested in spillway design to connect two given points. The slope and the curvature at both ends are specified for a CGVC 1 curve. For a CGVC 2 curve, with other conditions the same as CGVC 1, the curvature at the downstream end is not prescribed. A variable domain finite element scheme, in which the location of the free surfaces of the jet is determined simultaneously with the stream function, is described. The proposed curves with gradually varied curvature are used in four sample designs. Computational results with the finite element scheme indicate that the new designs give better pressure distribution than the conventional one. (Author's abstract) (Author's abstract) W90-07201

CASE STUDY OF A LABYRINTH WEIR SPILL-WAY.

Alberta Environment, Edmonton. Development and Operations Div. For primary bibliographic entry see Field 8A.

W90-07233

TRANSIENT HYDRAULIC MODEL FOR SIM-ULATING CANAL-NETWORK OPERATION. Nairobi Univ. (Kenya). Dept. of Agricultural En-

F. N. Gichuki, W. R. Walker, and G. P. Merkley. Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 67-82, January/February 1990. 8 fig. 21 ref. US Agency for International Development Contract AID/DAN-4127-C-00-2086-00.

Descriptors: *Hydraulic design, *Hydraulic engineering, *Irrigation canals, *Network design, Computers, Gates, Hydraulic models, Performance evaluation, Simulation, Weirs.

Field 8—ENGINEERING WORKS

Group 8B-Hydraulics

Renewed interest in the role of delivery networks in farm-level water use efficiency has prompted the development of a transient hydraulic simulation model for improving the design and operation of irrigation canal networks. Numerical solutions derived from surface irrigation analyses of the past decade provide rapid and accurate applications in a microcomputer environment. Surface irrigation microcomputer environment. Surface irrigation hydraulic modeling theory was adapted for use in branching canal networks and the results of the model verified. The model can simulate the filling and operation of canals and can handle bulk lateral and operation of canas and can nature outs access
outflow from turnouts and wastewater weirs. Gate
settings can be computed by the model with the
objective of maintaining stable flow depths at the
downstream end of each canal reach, thus providdownstream end of each canal reach, thus providing a basis for improved canal operation and more
efficient water management. The model can predict the overall hydraulic response in multiple
canal reaches with reasonable accuracy. Use of the
model to investigate hydraulic responses of canal
systems now can be made with a higher degree of
confidence. Model development and refinement
are continuing. (Rochester-PTT)
W90-07320

SHOOTING METHOD FOR SAINT VENANT **EQUATIONS OF FURROW IRRIGATION** California Univ., Davis. Dept. of Land, Air and

California Univ., Davis. Dept. of Land, Air and Water Resources.
W. W. Wallender, and M. Rayej.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 1, p 114-122,
January/February 1990. 2 fig, 1 tab, 15 ref.

Descriptors: *Furrow irrigation, *Hydrodynamics, *St Venant equation, Mathematical equations, Mathematical models, Performance evaluation, Prediction, Shooting method.

Flow in surface irrigation is subcritical and down-Flow in surface irrigation is subcritical and down-stream conditions can propagate upstream. The Saint Venant equations for advance and runoff phases of furrow irrigation were solved using a shooting or initial-value method, rather than using the two-point boundary method used previously. The shooting or initial-value method started from the downstream end and proceeded upstream against the flow. Saint Venant hydrodynamic equations were solved cell by cell for the flow area and flow, rate in the unstream direction given the and flow rate in the upstream direction, given the advance increment of the wave front and an estiadvance increment of the wave front and an esti-mate of the time required to achieve that advance. In contrast, with the two-point boundary-value solution for the full hydrodynamic model, the process started at the upstream end and swept downstream and then upstream during each iteration. Flow area and discharge were solved simultaneously for all nodes and advance distance was accounted for the civing time term. The aboving calculated for the given time step. The shootin model was tested and its accuracy compared with model was tested and its accuracy compared with that of the implicit model. Advance times predict-ed with both models were very close to field values initially (10 or 20 m), but tended to be overpredicted as the simulation continued. At 100 m distance (the maximum used), the field-measured advance time was 18 min, the implicit model pre-diction was 19 min, and the shooting model predic-tion was 20 min (Rochester-PTT) tion was 20 min. (Rochester-PTT) W90-07324

8C. Hydraulic Machinery

INTEGRATED PRODUCTION OF POWER AND WATER.

Saline Water Conversion Corp., Al-Khobar (Saudi Arabia). For primary bibliographic entry see Field 5F.

HYDROPOWER IN NEW ENGLAND: AN IN-

TRODUCTION.
For primary bibliographic entry see Field 6B.
W90-06699

SMALL HYDROPOWER DEVELOPMENT AND THE ENVIRONMENT: A SURVEY OF STATE AND FEDERAL LAW.

For primary bibliographic entry see Field 6E. W90-06701

ROLE OF THE FEDERAL ENERGY REGULA-TORY COMMISSION IN LICENSING SMALL HYDDOELECTRIC PROJECTS

Vermont Law School, South Royalton For primary bibliographic entry see Field 6E. W90-06702

IMPACT OF ECONOMIC AND FINANCIAL POLICIES ON THE DEVELOPMENT OF SMALL-SCALE HYDROELECTRIC FACILI-

THES IN NEW ENGLAND.
Thayer School of Engineering, Hanover, NH.
For primary bibliographic entry see Field 6E.
W90-06703

SELECTION OF THE LAYOUT OF THE POW-ERHOUSE OF A PUMPED-STORAGE STA-TION IN A DROP SHAFT.
S. G. Ageev, I. I. Ivanov, M. F. Sarkisova, E. N. Shestopal, and A. K. Shishkin. Hydrotechnical Construction HYCOAR, Vol. 23, No. 5, p 248-254, 1990. 5 fig. 6 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, pp. 16-20, May. 1989.

Descriptors: *Hydroelectric plants, *Pump tur-bines, *Pumped storage, *USSR, Design criteria, Draft tubes, Kanev Pumped Storage Station, Peak-ing power, Penstocks, Powerhouses.

Ing power, renstocks, rowerhouses.

The Kanev pumped-storage station (PSS), which is equipped with large mixed-flow reversible units for heads up to 112 m, serves as the source of peak-load energy and as a load regulator in the southern power system, with daily and weekly cycles of regulation and operating time up to 9 hr in a turbine regime and 7 hr in a pump regime. The PSS is being constructed near the Kanev hydroelectric station, using the station's reservoir as the downstream storage reservoir. The upper storage reservoir and powerhouse of the PSS are being constructed under complex geologic conditions on soft ground. The operating qualities of the new waterway with the reversible pump-turbine unit in a drop shaft were evaluated by direct comparison of the hydraulic, energy, and dynamic characteristics of the pump-turbine in a standardized PSS owerhouse with those of a nonstandard one. The complete performance of the model ORO-812-11 complete performance of the model ORO-812-11 pump-turbine unit was recorded for five variants of the powerhouse layout (2 penstock schemes and 3 types of draft tube). The structure of the flow in the penstock was investigated to assess the effect of curvilinear delivery on the operating conditions of the pump-turbine. In pump regimes the struc-ture of the flow for all types of draft tubes is identical. Before the runner the distribution of axial velocities is uniform with a maximum in the center of the core. The circumferential and radial components of the velocity are small. The angles of swirl of the flow do not exceed 3.5 deg. The coefficient of the flow do not exceed 3.5 deg. The coefficient of nonuniformity of the distribution of velocities is 1.2. The intensity of pressure fluctuations in the waterway of a reversible pump-turbine unit in the main pump regimes is low. The layout of the powerhouse of the PSS in drop shafts with a nonstandard waterway of the pump-turbine with a specific speed of 220 for heads of up to 100 m are comparable in their hydraulic negrey and dynamcomparable in their hydraulic, energy, and dynamic characteristics to a standardized waterway. The use of drop shafts when constructing a PSS on soft ground provides substantial technical and economic advantages. (Rechester, PTT) ic advantages. (Rochester-PTT) W90-06863

EQUIPMENT AND STANDS FOR MANUFACTURING METAL PRODUCTS OF HYDRO-ELECTRIC STATIONS,

V. E. Danilenko, and G. A. Polonskii. Hydrotechnical Construction HYCOAR, Vol. 23, No. 5, p 273-278, 1990. 3 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, pp. 34-38,

Descriptors: *Hydraulic equipment, *Hydroelectric plants, Automation, Economic aspects, Ma-

chine tools, Manufacturing, Metal fabrication, USSR.

More efficient use of plants manufacturing me-chanical equipment and metal products has several aims: reducing labor intensiveness, shortening the manufacturing cycle, reducing usage of materials and costs of production, introduction of new organizational methods, increasing product quality, improving working conditions, and increasing safety.

Marking off metal is complex and labor intensive
because it involves mathematical calculations and geometric constructions. To automate this oper-ation and improve quality, stationary automatic gas-cutting machines with photoelectric control (operating from scaled master drawings) or numerically controlled machines are used. A mechanized line for cutout of steel rolled products is nized line for cutout of steel rolled products is currently operating at the Chekhov Hydraulic Steelworks plant. Installation and delivery of sheets to the gas-cutting machines are accom-plished by sheet placers equipped with electromag-netic grips and mechanized roller tables. The PPD-1-65 machine employs a plasma-arc to cut sheet steel with a thickness of 5-80 mm. This semisteet with a tinckness of 2-80 mm. This semi-automatic machine consists of a plasma-arc cutter, a carriage with support, and operating and control panel. Various bending machines have been in-stalled, including sheet-bending rolls, edge-bending presses, and sheet-bending machines. Small porta-ble drilling machines (SK-10, STz-20, SKA-20, and ble drilling machines (SK-10, STs-20, SKA-20, and SK-25) are being used in shipbuilding. The can adjust the cutting regime depending on the strength of the material being worked. The RN-24 thread-cutting machine provides a high-quality of thread in all materials, automatic incision of the tap along the axis of the holes, and prevention of the tool from breaking. To save stainless steel, a device is used for surfacing square carbon steel of the main (working) track of embedded parts with a stainless layer. The device consists of a stand with mechanical clamps and 12 m in length; a suspended head moves along guides in the stand. A promising head moves along guides in the stand. A promising technology is the assembly of pieces using electromagnets and permanent magnets; these devices offer rapid action and no moving parts. At the offer rapid action and no moving parts. At the Kama Hydraulic Steelworks plant automatic sub-merged-arc welding of large pipelines with a diam-eter up to 3000 mm and length of links to 6000 mm is carried out on a mechanized rotating stand. (Rochester-PTT) W90-06867

LOCATION OF TRASH RACKS ON UNDER-GROUND PRESSURE CONDUITS OF HYDRO-ELECTRIC STATIONS

V. F. Ilyushin, and S. N. Krylova

Hydrotechnical Construction HYCOAR, Vol. 23, No. 5, p 278-287, 1990. 6 fig, 1 tab, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, pp. 38-46, May, 1989.

Descriptors: *Hydraulic design, *Hydroelectric plants, *Pressure conduits, *Trash racks, *Under-ground powerplants, Comparison studies, Design criteria, Performance evaluation, USSR, Water

Pressure intakes usually are used under conditions Pressure intakes usually are used under conditions of substantial variation of water level in the upper pool between the normal pool level (NPL) to the dead storage level (DSL). Many examples exist in which pressure intakes are located 50-80 m or even more than 100 m below NPL. With deep regulating reservoirs, pressure intakes usually are used in combination with underground pressure conduits of the hydroelectric station (nower tunnels or nencombination with underground pressure conduits of the hydroelectric station (power tunnels or penstocks). Pressure intakes supplying the underground conduits can be divided into two types: tower and bank (with a shaft or special underground room for gates). Experience in the design, construction, and operation of deep intakes of hydrostations shows that cleaning of their racks is a serious problem, and the construction of the intakes themselves is associated with large expenditures of time and expense, particularly in seismically active regions. The advantages and disadvantages of various layouts for trash racks on the water-supply conduits of hydroelectric stations can be shown by examining several examples of unsubbe shown by examining several examples of unsub-merged tower intakes, submerged tower intakes,

Hydraulic Machinery—Group 8C

temporary intake (Rogun Hydrostation), intakes with removable conical or cylindrical racks, and bank intakes. Examples exist of various locations for the trash racks, including: in a special shaft in the initial section of the conduit (Lake Fannish, England), in tunnels above the inlet to the penstocks (France), and at the end of intake works in a surge shaft (Arnstein hydrostation, Austria). Unsubmerged tower intakes with large height are complex in design, especially in seismic regions, and are labor-intensive to construct and operate. Submerged tower intakes are less labor-intensive and are sufficiently reliable when rubbish content is low in the reservoir. Bank intakes with their large depths are insufficiently reliable owing to the impossibility of using known trash cleaning devices, and because rubbish striking the inclined rack cannot slide down or be thrown off by the opposite pressure occurring when loading of the turbine unit is changed. Underground trash racks with hydraulic flushing is the most promising approach for the a deep headwater tunnel. (Rochester-PTT)

PUMP-STATION INTAKE-SHOALING CONTROL WITH SUBMERGED VANES.

Iowa Univ., Iowa City. Inst. of Hydraulic Research.

scatch.
T. Nakato, J. F. Kennedy, and D. Bauerly.
Journal of Hydraulic Engineering (ASCE)
JHEND8, Vol. 116, No. 1, p 119-128, January
1990. 13 fig, 3 ref.

Descriptors: *Hydraulic design, *Hydraulic engineering, *Hydraulic models, *Hydraulic structures, *Model studies, *Pumping plants, *Shoals, Hydroelectric plants, Hydroelectric power, Intakes, Iowa.

The water intake at Iowa Power's Council Bluffs Power Station Unit 3, located along the left concave bank of the Missouri River near Council Bluffs, Iowa, has suffered from chronic fine-sand shoaling problems both within the intake bays and just outside the intake structure. In order to maintain the pump-intake bays sediment-free, an innovative scheme of promoting a deep scour trench in front of the intake was developed using a 1:36 scale movable-bed model. On the basis of the model testing results, an array of submerged vanes, comprising two rows of 13, 9-ft. (2.7 m) wide sheet pile vanes, were installed in the prototype in August 1985. The prototype performance of these vanes has been found to be excellent during the past 3.5 yr, and no dredging has been required. The positive riverbed-scouring approach developed in this study may be a viable solution to resolve persistent sediment-deposition problems at numerous riverside water intakes. (Author's abstract)

EFFICIENCY OF CONSTRUCTING HYDRO-ELECTRIC STATIONS AND EXPERIENCE OF OPERATING THE SAYANO-SHUSHENSKOE HYDROPOWER COMPLEX.

V. I. Bryzgalov. Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 301-304, 1990. 1 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 1-4, June, 1989.

Descriptors: *Economic aspects, *Hydroelectric plants, *Powerplants, *Soviet Union, Capital costs, Economic justification, Government finance, Hydraulic turbines, Investment, Turbines.

As an alternative solution to the problem of accelerating the introduction of fixed capital and its productivity, it is suggested that an initial (temporary or permanent) hydroelectric station be constructed at the first stage of construction of the hydro development. Such a station, for example, could be accommodated in the powerhouse of the future large hydrostation at the place specified for installation of the reserve turbine-generator units. The initial hydrostation could also be used to solve future problems, such as counterdevelopment of the lower pool. The establishment in the design of reserve places for future units calculated for the development of power systems is routine and nec-

essary. Future expenditures could be reduced since it would not be necessary to add new powerhouses to the existing dams. Similar solutions were used at the Nurek and Sayano-Shushenskoe hydrostations, when temporary turbine runners were installed in order to use the energy resources at partial heads. More money might be saved if the places of reserve units of a large hydrostation were used for accommodating the units of the initial hydrostation. Another important aspect is the preparation of the reservoir bed, particularly its deforestation. Absence of access roads and steepness of the bed relief often impede deforestation. Construction of the initial hydrostation with a small head makes it possible to create at least a small reservoir, but one sufficient for organizing on its surface floating facilities for felling timber in the bed of the future large reservoir, and for its processing and transporting. Finally, it would help to involve in the design and construction of hydro developments all those government departments that ultimately become either direct water users or are closely related. (Mertz-PTT)

USE OF THE ENERGY OF SMALL RIVERS AND IRRIGATION SYSTEMS IN THE KIRGIZ

For primary bibliographic entry see Field 8A. W90-07163

SUBSTANTIATION OF LAND PROTECTION IN THE LOWER POOLS OF HYDROELECTRIC STATIONS.

IN THE LOWER POOLS OF HYDROELEC-TRIC STATIONS.

N. I. Khrisanov, and M. A. Mereminskii.
Hydrotechnical Construction HYCOAR, Vol. 23,
No. 6, p 345-347, 1990. 1 fig, 4 ref. Translated from
Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 34-36,
June. 1989.

Descriptors: *Computer-aided design, *Hydroelectric plants, *Hydroelectric power, *Levees, *Model studies, *Soviet Union, Agricultural water, Computer programs, Economic aspects, Polders, Water management, Water resources management.

The operating regime of a hydroelectric station in many respects is determined by the requirements of the nonenergy participants of the water-management complex located in the lower pool. Effective functioning of the complex as a whole is often related to restrictions on releases of a hydro development with a hydroelectric station due to the requirements of agriculture in the downstream zone. This entails a decrease of the efficiency of the hydroelectric station: worsening of its power indices and, as a consequence, limitation of the participation of the hydroelectric station in covering the load curve of the power system, which causes additional consumption of fuel at thermal power stations. Levee systems in the lower pool of a hydrostation should be regarded as a measure aimed at increasing the efficiency of using the power and land resources as part of the water management complex. These systems make it possible, on the one hand, to remove the restrictions from the regimes of the hydrostation and to improve its power and economic indices and, on the other, to effectively use the protected lands in agriculture by creating polders. For computer-aided design of levee systems with consideration of their effect on the water management complex a mathematical economic model was developed in which optimal designing of the levee systems is carried out using minimum calculated discounted costs as the criterion. The parameters being optimized are: the plan configuration (area of the lands being protected), and type and height of levees the method, algorithms, and computer programs were used for optimal formation of levee systems in the lower pool of the Dal'nerechensk hydrostation on the B. Ussurka River. This made it possible to substantiate the protection of 60,000 hectares of lands during operation of the hydrostation in a normal regime and 75,000 hectares in the case of lands during operation of the hydrostation in a normal regime and 75,000 nectares in the case of lands during operation of the necrease of lands du

CONDITIONS OF CONVERTING A HYDRO-ELECTRIC STATION WITH HORIZONTAL

BULB UNITS TO A HYDROELECTRIC STA-TION-PUMPED-STORAGE STATION REGIME.

S. I. Potashnik, I. I. Ivanov, V. A. Osadchuk, and Y. A. Yukhnov.

No. 6, p 348-352, 1990. 6 fig. Translated from Gidtekhnichoeskoe Stroitel'stvo, No. 6, p. 36-39, Iune 1989.

Descriptors: *Electrical equipment, *Hydroelectric plants, *Pumped storage, *Soviet Union, Hydroelectric power, Nuclear powerplants, Thermal powerplants.

Trends of development in the power industry and the further increase of generating capacities at thermal and nuclear power stations with large self-contained units require the accelerated introduction of mobile facilities for increasing the quality of energy supply and providing reliability of operation. Problems of covering the sharp peak loads and filling the off-peak periods of the load curves are being solved successfully by pumped-storage stations, which simultaneously perform the functions of an emergency standby, frequency regulation, and regulator-consumer of electric energy. Problems of providing reliability of operation of equipment arise in the Southern Interconnected Power System. On-site investigation of the equipment of the Kiev hydroelectric station-confirmed the possibility in principle of converting the horizontal bulb units to a hydroelectric station-pumped storage station regime in the presence of a cascade of reservoirs with impounded pools. The most acceptable and reliable method of starting horizontal units with a submerged waterway is frequency starting from adjacent machines with power consumption with the runner blades slightly turned. Constant operation of standard horizontal bulb units in pump regimes is difficult owing to the high level of hydrodynamic loads on their operating components. With consideration of the acute need for mobile regulating facilities, it is necessary to recommend the accelerated reconstruction of operating bulb units for operation in the reverse regime at a head of 7-12 m and their experimental operation. Pump regimes at hydrostations also have a sanitizing effect on biological processes in the reservoir. (Mertz-PTT)

MODERNIZATION OF THE HYDROME-CHANICAL EQUIPMENT OF THE CHIRKEY HYDROELECTRIC STATION.

Z. L. Zelenevskii.

Hydrotechnical Construction HYCOAR, Vol. 23, No. 6, p 353-355, 1990. 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 39-42, June, 1989.

Descriptors: *Gates, *Hydraulic turbines, *Hydroelectric plants, *Pumps, *Soviet Union, Dams, Reservoirs, Seals, Turbines.

The Chirkey hydrostation on the Sulak River in Dagestan, USSR, has mixed-flow turbines, each with a capacity of 250 megawatts, rapidly falling vertical gates of the turbines controlled by hydraulic hoists, vertical guard gates of the upstream and downstream pools and racks of the intakes of the turbines operated by gantry cranes, and radial gate of the outlet operated by block-and-tackle winches. The main hydraulic structure is a concrete arch dam with a height of 232.5 m and crest length of 333 m. The first unit was put into operation in December 1974 and the last in June 1976. The reservoir reached the design elevation for the first time in October 1978. Modernization began in the fall of 1976 with reconstruction of the lobe seals of the turbine shafts. The cooling system of the unit was modernized, due to entry of water into the oil baths of the bearings and cessation of cooling of the unit owing to failure of the electric motors of the cooling pumps and their automatic devices. In 1977 cracks were noted on the turbine runners in the zone of welding the blade to the hub. Measures to prevent the formation of cracks were taken on all turbines in 1980-1981. Elastic metal-plastic segments in the thrust bearings and guide bearings were introduced in 1982 and anticavitation meas-

Field 8—ENGINEERING WORKS

Group 8C-Hydraulic Machinery

ures were implemented in 1985. In 1979 half of the guard gates of the draft tubes had to be modernized. According to a calculation of the arch dam and its state, a rise of the reservoir level by 1 m is possible. In connection with this, in April 1988 the radial gate of the outlet was built up for the possibility of such a rise. (Mertz-PTT) W90-07173

IMPROVED ALGORITHM FOR HYDROPOW-ER OPTIMIZATION.

Manitoba Univ., Winnipeg. Dept. of Civil Engi-

For primary bibliographic entry see Field 3E. W90-07349

DEVELOPMENT, TESTING AND THE ECO-NOMICS OF A COMPOSITE/PLASTIC SEA-WATER REVERSE OSMOSIS PUMP. ISTI Delaware, Inc., Lewes. For primary bibliographic entry see Field 3A. W90-07437

PRACTICAL EXPERIENCE IN SCALE CON-

For primary bibliographic entry see Field 3A. W90-07451

OPERATIONAL EXPERIENCE OF ONCE THROUGH MSF DESALINATION UNITS. Ministry of Electricity and Water, Safat (Kuwait). For primary bibliographic entry see Field 3A. W90-07452

SOME ASPECTS OF THE DEVELOPMENT AND OPERATION OF THE DESALINATION INSTALLATIONS WITH HORIZONTAL-TUBE THIN-FILM EVAPORATORS.

demiya Nauk SSSR, Sverdlovsk. Inst. of Physical Chemistry.
For primary bibliographic entry see Field 3A.
W90-07461

8D. Soil Mechanics

CALCULATION OF THE BEARING CAPACITY OF SOIL FOUNDATIONS OF HYDRAULIC STRUCTURES WHICH ARE ANISOTROPIC WITH RESPECT TO SHEAR STRENGTH.

A. V. Shkola Hydrotechnical Construction HYCOAR, Vol. 23, No. 4, p 190-193, 1990. 2 fig, 6 ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 22-24, April, 1989.

Descriptors: *Anisotropy, *Foundations, *Hydraulic structures, *Soil strength, *Stress-strain curves, Foreign design practices, Mathematical analysis, Shear, Soil physical properties, Soviet Union.

When solving problems of the stress-strain state of anisotropic soils, the main attention has been devoted to consideration of the anisotropy of deformation and seepage properties. Of practical interest for hydraulic structures are problems of the bearing capacity when regions of the limit stress state have global development. Here the need arises to take into account the anisotropy of mechanical properties. Using hodographs, mathematical equations were developed to calculate the bearing capacity of soil foundations which are anisotropic with respect to shear strength. Solution of the problem was reduced to three main component parts, identification, kinematic and static, which are completely determined and capable of realizaare completely determined and capable of realiza-tion in particular calculations. When the angle of internal friction and cohesion are constant, the internal friction and cohesion are constant, the solution obtained degenerates into the known one for isotropic soil. No constraints are imposed on the form of hodographs of the angle of internal friction and cohesion, and their approximation by analytic expressions is not required. The solution does not require additional special characteristics of the soils and is based on standard shear tests with various orientations of the shear plane. (Ver-Noov-PTO Nooy-PTT)

W90_07043

DEVELOPMENT AND INTRODUCTION OF THE OHTPI-2 OPTIMAL HYDRAULIC TRANSPORT PERFORMANCE INDICATOR. For primary bibliographic entry see Field 8B. W90-07165

8E. Rock Mechanics and Geology

STUDIES OF THE SEISMIC CONDITIONS OF STUDIES OF THE SEISMIC CONDITIONS OF HYDROPOWER CONSTRUCTION SITES.

A. I. Savich, A. V. Suvilova, M. I. Kruglyakov, V. G. Vladimirov, and A. D. Mikhailov.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 4, p 179-184, 1990. 16 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 14-19, april 1990. April, 1989.

Descriptors: *Damsites, *Engineering geology, *Geophysical surveys, *Hydroelectric plants, *Seismic properties, *Site selection, *Soviet Union, Dams, Earthquake engineering, On-site investiga-tions, Seismology.

A considerable number of power facilities being designed, under construction, and being operated by organizations of the USSR Ministry of Power and Electrification (Minenergo) are located in regions of increased and high seismicity (from 6 to 9). The composition, extent, and cost of special gions of increased and high seismicity (from 6 to 9). The composition, extent, and cost of special seismic assessment measures depend on the class of structure being designed and on the natural conditions at the construction sites. A specialized seismological division was created about 20 years ago which carries out its own work in close contact with the survey services of the head institute, its branches, and affiliates. Site analysis includes estimates of the assumeters of seismitive (declaration) branches, and affiliates. Site analysis includes estimates of the parameters of seismicity (localization and extent of earthquake zones), and of the parameters of ground oscillations at the site caused by earthquakes. The methods of evaluating seismic hazard used at Minenergo when selecting sites for large hydraulic structures are based on a combination of genetic (determined) and probabilistic appearance of the structure of th tion of general (determined) and producistic ap-proaches. One of the most complex problems when evaluating seismic conditions is the problem of determining the maximum possible magnitudes of earthquakes (M sub max) within the detected PEF earthquakes (M sub max) within the detected PEF zones (zones of possible occurrence of earthquake). Various methods of determining M sub max are mentioned, including a complex one based on a comprehensive study of the geological, geomor-phological, geophysical, and seismological charac-teristics of the region. The current practice of designing and constructing power objects in seis-mically active regions requires advancement in the completeness and reliability of information about the seismic conditions in the territories where hythe seismic conditions in the territories where hy draulic structures are to be sited. (VerNooy-PTT)

DETERMINATION OF THE PARAMETERS OF A FOUNDATION MODEL FROM ENGINEERING-GEOLOGICAL SURVEY DATA.

K. V. Ruppeneit, and V. P. Kustov. Hydrotechnical Construction HYCOAR, Vol. 23, No. 4, p 185-189, 1990. 3 fig, 1 tab, 7 ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 19-21, April, 1989.

Descriptors: *Clays, *Engineering geology, *Foundations, *Model studies, *Permeability coefficient, *Seepage, *Structural settlement, Data interpretation, Foreign research, Laboratory methods, Mathematical models, Nuclear powerplants, Soil physical properties, Soviet Union

In calculating the settlement of structures on clay soils, there is a need to include seepage characteris-tics and initial gradients of the soils. To determine tics and initial gradients of the sons. To electrimite the permeability coefficients and initial gradients of clay soils, an instrument has been designed which is distinguished by the fact that only one-dimensional seepage flow is realized in it. This makes it possible to conduct investigations at large gradi-ents of the head considerably exceeding those usu-ally used. Pressurized water was fed to a soil

specimen located in a sealed chamber through a specimen located in a sealed chamber through a perforated plate, and the seepage discharge was determined from a water-gauge capillary tube in a regime of steady seepage flow for each step of the gradient of the head. Completely analogous results confirming the existence of initial gradients and order of the values obtained are detailed. It was noted that a decrease of the permeability coefficients is observed for heads i < 100 (i = the axis or gradient), which leads to an increase of the initial gradients in comparison with those determined by the method, and the initial gradients in comparison with those determined by the method, and the initial gradients in comparison. increase with decreasing temperature. To estimate the order of deformation modulus values of incompressible clays, a chamber was made for determining the modulus of volume change, and undrained tests were conducted for determining the modulus of volume change of various clay soils. From test data, calculations were made to deter-mine expected settlements of a nuclear power stamine expected settlements of a nuclear power sta-tion reactor room and compared with measured settlements. The separation of the foundation bed into compressible and incompressible layers does not reflect the physical processes of foundation bed deformation occurring in the prototype. It would be more correct to single out a layer in which the dominant process is consolidation of the soil under designes conditions, and an underlying layer in drainage conditions, and an underlying layer in which drainage and consolidation do not occur. (VerNooy-PTT)

W90-07042

MATHEMATICAL MODEL OF THE 'DAM-FOUNDATION' STATIC SYSTEM OF THE KHUDONI HYDROELECTRIC STATION.

B. V. Fradkin, and N. A. Militeev Hydrotechnical Construction HYCOAR, Vol. 23, No. 4, p 205-213, 1990. 7 fig, 8 ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 32-38,

Descriptors: *Arch dams, *Dam design, *Dam foundations, *Finite element method, *Mathematical models, *Soviet Union, Design criteria, Elastic properties, Engineering geology, Hydroelectric plants, Model studies, Reservoir design, Stressstrain curves. Three-dimensional model

The arch dam of the Khudoni hydroelectric station The arch dam of the Khudon hydroelectric station is one of the most technically complex and critical hydraulic structures presently being constructed in the Soviet Union. The 200 meter high dam is being constructed at a site having in the upper part of the left-bank abutment a 50 meter stratum of Quaternary deposits and a zone of tectonic disturbance with a width of 10 to 15 meters in the middle part of the same slope. The arch dam is in the form of a symmetric shell of double curvature joining the symmetric snei of double curvature joining the foundation by means of a saddle and gravity abut-ments. A mathematical model of the dam-founda-tion static system has been developed using de-tailed finite-element grid data. Examination is made of the three-dimensional problem of elasticity of the three-dimensional problem of elasticity theory for an inhomogeneous region modeling the dam, saddle, abutments, and a part of the rock mass surrounding the structure. A three-dimensional grid of the region modeling the saddle, abutments, and foundation was constructed by using the coordinates of the dam-foundation contact points obtained when constructing the finite-element grid for the dam, cross sections, and plane element grid for the dam, cross sections, and plane sections along the dam and foundation pit, geological sections, and topographic maps of the construction region. Stress-strain is described for the upper face and downstream face of the shell, and left bank abutment above 580 meters elevation. The most stressed parts of the support contour and dam as a whole are sections of the saddle on the left bank between elevations 540 to 580 meters and on the right bank between elevations 540 to 580. bank between elevations 540 to 580 meters and on the right bank between elevations 540 to 580 meters. This model makes it possible to solve promptly numerous problems arising at stages of the design, construction, and operation of the structure; to analyze the effect of variability of diverse natural, design, and technological factors on the stress-strain state of the structure; to test simpler calculation schemes not reproducing in detail the interaction of the thin shell with the gravity abutments of the complex form and foundation and to evaluate the effect of the reservoir on

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the stress-strain state of the structure. (VerNooy-PTT) W90-07046

ARCH DAM RESPONSE TO NONUNIFORM SEISMIC INPUT. Colorado State Univ., Fort Collins, Dept. of Civil

Engineering.
For primary bibliographic entry see Field 8A.
W90-07199

8F. Concrete

INCREASE OF THE RELIABILITY OF POLY-MER COATINGS OF CONCRETE, E. A. Krivoi, and V. K. Shardakov.

Hydrotechnical Construction HYCOAR, Vol. 23. No. 5, p 254-257, 1990. 4 fig, 1 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, pp. 20-22,

Descriptors: *Coatings, *Concrete additives, *Concrete technology, *Polymers, Comparison studies, Concretes, Performance evaluation, Waterproofing.

Polymer materials used for improving a number of properties of ordinary cement concretes (eg, resistance to corrosive effects, impermeability to fluids under pressure, crack resistance, resistance to abrasion and cavitation, and decorative and artistic suitability) recently have become widespread in construction practice. The existing methods of combining polymers with concretes are still rather complex and do not always provide reliability and longevity. More promising are concrete articles with a polymer coating formed during molding, which can be made without substantial restructuring of the established methods of production at construction industry supply factories. A comparative evaluation of the reliability of cohesion of the face laver with the hardened concrete was carried under pressure, crack resistance, resistance to abrative evaluation of the reliability of cohesion of the face layer with the hardened concrete was carried out by measuring the stresses under normal pulling on cube specimens of the same compressive strength with a polymer coating obtained by two methods: (1) application of the polymer compound to the hardened concrete and (2) application on the formwork during molding. A concrete mix of compressive strength of V20 was used for making the precimens. Saw cuts of various depths were made pressive strength of V20 was used for making the specimens. Saw cuts of various depths were made into some of the specimens on both sides of metal 'mushrooms' that were used to apply force to the polymer surface. The experiments showed that the cohesive strength of the concrete with the polymer coating, when formed during molding, was approximately 4 times greater than when the polymer was applied to hardened concrete. The plane of detachment passes through the transition layer between the polymer facing and the concrete. It also was demonstrated that to reduce the cost of the coatings, filler could be introduced into the polymer at up to 200% of the mass of the binder. Further addition of filler makes application to the formwork difficult because of increased polymer formwork difficult because of increased polymer viscosity. (Rochester-PTT) W90-06864

PROPERTIES OF ASPHALTIC CONCRETE OF DIAPHRAGMS AND FACINGS OF ROCKFILL

L. N. Rasskazov, and K. S. Sherimbetov. Hydrotechnical Construction HYCOAR, Vol. 23, No. 5, p 262-268, 1990. 5 fig, 1 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, pp. 26-30, May, 1989.

Descriptors: *Asphaltic concrete, *Coatings, *Concrete technology, *Dams, *Rockfill dams, Comparison studies, Concretes, Diaphragms, Earth dams, Performance evaluation, Temperature effects, USSR, Waterproofing.

Asphaltic concrete diaphragms have gained wide use in construction of dams in Europe, Asia, and Central America. At least five dams 90 m or more in height have been build with this method. Specialists of the laboratory of waterproofing of the B.E. Vedeneev All-Union Scientific-Research Institute of Hydraulic Engineering (VNIIG) and

earth dams of the V.V. Kuibyshev Moscow Insti-tute of Civil Engineering (MISI) are engaged in studies of asphaltic concrete and the design of watertight elements. The mathematical theory of experimental design was used in conducting studies of various compositions of asphaltic concrete as the diaphragm material for rockfill dams in a combined stress state and at various temperatures. Four factors were considered in preparing the asphaltic factors were considered in preparing the asphaltic concrete: quantity of coarse aggregate, quantity of BND-60/90 bitumen, initial hydrostatic compression, and temperature. The present study concerns fine-grained asphaltic concrete. A triaxial compression instrument was used for determining the strength and deformation characteristics. The experiments showed that the angle of internal friction for 7% bitumen in excess of 100% of the mineral part is practically independent of temperature. The strength of the material increases due to cohesion, which increases about five-fold upon a drop in temperature from 200 C to 10 C. Investigation of deformation properties of asphaltic concrete temperature from 200 C to 10 C. Investigation of deformation properties of asphaltic concrete showed that the modulus of volume change for compression of 0.1 MPa varied by 4-7 times depending on the temperature. (Rochester-PTT) W90-06865

EVALUATION OF THE MARGIN OF STRENGTH OF CONCRETE OF THE SAYANO-SHUSHENSKOE DAM.
V. M. Vlasov, V. I. Veretyushkin, A. P. Nikolaev, A. S. Moiseenko, and L. M. Deryugin.
Hydrotechnical Construction HYCOAR, Vol. 23, No. 4, p 225-233, 1990. 5 fig, 3 tab, 11 ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 48-53, April, 1989.

Descriptors: *Compressive strength, *Concrete dams, *Concrete testing, *Construction materials, *Dam construction, *Materials testing, Concrete properties, Construction joints, Dam stability, Mathematical analysis, On-site measurements, Sayano-Shushenskoe Dam, Soviet Union, Strength, Stress analysis.

In the Soviet Union the margin of strength of a massive hydraulic structure is determined by the massive hydraulic structure is determined by the strength condition according to an equation incor-porating the prism strength of concrete, the coeffi-cient of reliability of concrete in compression, and the probability index. The margin of strength of concrete in the Sayano-Shushenskoe Dam was cal-culated. One parameter, the coefficient of reliabil-ity for the dam (equal to 1.25) compensates for the increase of stress in the structure from defective concrete not participating in work. Laboratory increase of stress in the structure from defective concrete not participating in work. Laboratory core tests were used for evaluating the strength of the concrete of the dam in uniaxial compression and triaxial compression. Results of experimental investigations and calculations to evaluate the strength of joints of concrete elements were used for evaluating the strength of concrete in the immediate vicinity of the grouting joints. The most stressed region in the dam is the downstream shoulder; check calculations showed that principal compressive stresses in the downstream shoulder are 11.5 MPa. In conclusion, the concrete of the Sayano-Shushenskoe dam has a sufficient margin of strength. The method developed for evaluating Sayano-Shushenskoe dam has a sufficient margin of strength. The method developed for evaluating the margin of strength is needed to refine the strength, stress state, and margin of strength determined by calculations and data from on-site measurements. An analysis of the margin of strength of the Sayano-Shushenskoe hydroelectric station will help to design and construct more economical concrete structures. (VerNooy-PTT) W90-07049

STATE OF THE CONTACT OF CONCRETE WITH ROCK UNDER THE UPSTREAM FACES OF DAMS

OF DAMS.

A. N. Marchuk, and M. A. Marchuk.
Hydrotechnical Construction HYCOAR, Vol. 23,
No. 6, p 334-340, 1990. 3 fig, 2 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p. 26-31, June, 1989.

Descriptors: *Concrete dams, *Foundation rocks, *Limiting factors, *Rock properties, Dam design, Dam foundations, Dam stability, Shear stress,

The contact of the upstream faces of concrete dams with the rock foundation arouses particular interest as the most probable place for occurrence of the limit state. Accumulation of on-site observations at several dams and theoretical investigations tions at several dams and theoretical investigations reveal a number of important regularities. The state of the rock-concrete contact under the upstream faces of dams can serve as a criterion of their safety. Its disruption with opening of a fracture should be considered a defect of the structure, the initial state of the second limit state. When the initial state of the second limit state. When designing concrete dams on high-modulus rock foundations it is necessary to perform a check calculation of the shear stability in the presence of an open contact with consideration of an increase of uplift and to provide special design measures and appropriate methods of performing works. The problem requires further thorough study and is the key problem in the theory of the limit state of concrete dams working in accordance with the scheme of the two-dimensional problem. Mertzschem of the two-dimensional problem. scheme of the two-dimensional problem. (Mertz-

INFLUENCE OF STRUCTURAL PARAM-ETERS ON ABRASION-EROSION RESIST-ANCE OF VARIOUS REPAIRING MORTARS. Institut de Recherche de l'Hydro-Quebec, Var-

Canadian Journal of Civil Engineering CJCEB8, Vol. 17, No. 1, p 12-18, February 1990. 7 fig. 3 tab,

Descriptors: *Abrasion, *Materials testing, *Mortar, Cements, Durability, Epoxy, Grouting, Maintenance, Polymers.

Slurry erosion tests were performed on various types of repairing mortars in order to determine the factors influencing the abrasion-erosion resistance of some mortars. An in-house built apparatus was used, which produced a slurry jet that impinged the surface of mortar specimens with an incidence angle of 45 degrees and a velocity of 18.5 m/s. The results showed that the epoxy mortars were the most group resistant compared with tars were the most erosion resistant compared with cementitious grouts and polymer-modified cement-based mortars. The erosion of mortars is controlled based mortars. The erosion of mortars is controlled by the war of the binder (epoxy or cement paste), and a strong relation exists between the erosion resistance of the mortar and the absence of micro-porosity in the binder. The results also suggest that to minimize the exposed areas of the binder, well-graded, i.e., small-size and large-size, sand particles should be used. (Author's abstract) W90-07234

8G. Materials

INCREASE OF THE RELIABILITY OF POLY-MER COATINGS OF CONCRETE. For primary bibliographic entry see Field 8F. W90-06864

EXPERIENCE IN USING DETRITAL DOLO-MITES FOR CONSTRUCTING EARTH DAMS. For primary bibliographic entry see Field 8A. W90-06866

DESIGNING SAFETY INTO DAMS. Gibb (Alexander) and Partners, London (Eng-For primary bibliographic entry see Field 8A. W90-06871

SOME CONSIDERATIONS OF THE DURABIL-TTY OF DAMS, COBA S.A., Lisbon (Portugal). For primary bibliographic entry see Field 8A. W90-06873

CORROSION MANAGEMENT IN WATER SUPPLY SYSTEMS. For primary bibliographic entry see Field 2F. W90-06945

Field 8—ENGINEERING WORKS

Group 8G-Materials

FLEAIBLE STRUCTURES: REFERE MANUAL ON DESIGN.
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 8A.
W90-06947 STRUCTURES: REFERENCE

STUDIES OF THE SEISMIC CONDITIONS OF HYDROPOWER CONSTRUCTION SITES. For primary bibliographic entry see Field 8E.

EVALUATION OF THE MARGIN STRENGTH OF CONCRETE OF SAYANO-SHUSHENSKOE DAM. THE For primary bibliographic entry see Field 8F. W90-07049

ESSENCE OF THE COEFFICIENT OF EFFECTIVE UPLIFT AREA.
For primary bibliographic entry see Field 8B.
W90-07050

EXPERIENCES WITH A HIGHLY ALLOYED STAINLESS STEEL IN DESALINATION PLANTS AND OTHER ARABIAN GULF INDUSTRIAL PLANTS. Avesta Jernverk A.B. (Sweden).
For primary bibliographic entry see Field 3A.
W90-07448

EXPERIENCE PLANTS IN LIBYA. WITH DESALINATION Department of Chemical Engineering, Tripoli GSPLAG, Libya. For primary bibliographic entry see Field 3A. W90.07456

LOCALIZED CORROSION AT WELDS IN STRUCTURAL STEEL UNDER DESALINATION PLANT CONDITIONS, PART I: EFFECT OF SURFACE ROUGHNESS AND TYPE OF WELDING ELECTRODE.

University of Petroleum and Minerals, Dhahran (Saudi Arabia). Petroleum and Gas Technology

For primary bibliographic entry see Field 3A. W90-07457

LOCALIZED CORROSION AT WELDS IN STRUCTURAL STEEL UNDER DESALINA-TION PLANT CONDITIONS, PART II: EFFECT OF HEAT TREATMENT, TEST TEMPERA-TURE AND TEST MEDIA.

University of Petroleum and Minerals, Dhahran (Saudi Arabia). Petroleum and Gas Technology

For primary bibliographic entry see Field 3A. W90-07458

LIGHT GAUGE WELDED TITANIUM TUBES FOR SEAWATER DESALINATION PLANTS.
K. Kohsaka, K. Kitaoka, Y. Masuyama, M.
Oshiyama, and M. Yamamoto.
Desalination DSLNAH, Vol. 3, No. 1/3, p 429446, November 1989. 18 fig, 4 tab, 10 ref.

Descriptors: *Desalination plants, *Materials testing, *Titanium, *Tubes, Copper, Corrosion control, Equipment, Performance evaluation, Water treatment facilities, Welding.

Light gauge welded titanium tubes have been widely used for condenser tubes at nuclear and fossil power stations, and for seawater desalination tossi power stations, and for seawater desalination plants. More than several thousand metric tons of titanium tubes have been used already. Factors that influence the corrosivity of this titanium include: NaCl concentration and temperature; pH of brine; dissimilar metal contact; the usage of sealant to fill clearances between titanium surfaces, and the surface conditions of the titanium surfaces. Three common methods for preventing crevice corrosion of titanium tubes are: (1) seal welding the titanium tube to the tube sheet; (2) using Ti-Pd alloy tubes; and (3) surface treatment with pallidium. The seal welding method was the most certain and cost-effective method. The corrosion potential of titaniemective method. The corrosion potential of titanium, copper alloys, and other materials measured in aerated seawater at 25 C and deaerated 6% NaCl solution at 100 C, were examined. Since most copper alloys have lower corrosion potentials than titanium, their contact with titanium in seawater may cause galvanic corrosion on the side of copper alloys. Cathodic protection is applied to prevent alitys. Cathodic profection is applied to prevent the tubes from galvanic corrosion. The cathodic potential required to do this is -0.5 to -0.75 v (SCE) in relatively low temperature zones, and -0.5 to -0.65 v (SCE) in high temperature zones, to prevent both galvanic corrosion of copper alloys and hydrogen absorption. (Lantz-PTT)

CORROSION REHAVIOUR OF ALUMINUM. BASE ALLOYS IN DESALINATION PLANTS. Akademiya Nauk SSSR, Sverdlovsk. Inst. of Physical Chemistry.
O. M. Lebedeva, A. H. Lebedev, M. N. Fokin, S.

V. Lomakina, and T. A. Severorova.

Desalination DSLNAH, Vol. 3, No. 1/3, p 457-458. November 1989.

Descriptors: *Aluminum, *Corrosion, *Desalina-tion plants, *Materials testing, Alloys, Chromium, Hydraulic equipment, Magnesium, Strontium, Tubes, Water temperature, Zinc.

High-temperature corrosion of construction materials in seawater is one of the reasons for capacity loss and failure of desalination plants. Corrosion of heat exchange tubes, the cost of which is about 40% of plant cumulative cost, is especially hazardous because of high maintenance expenses. Aluminum-base alloys are being considered for heat ex-change tubes because they allow substantial reducchange tubes because they allow substantial reduc-tion of the capital costs for desalination plant man-ufacturing. The main obstacle for wide use of aluminum-base alloys is their susceptibility to pit ulacturing. The main obstacle for wide use of aluminum-base alloys is their susceptibility to pit corrosion in hot seawater. The experiments were run on aluminum-base alloys with Mg, Cr, Mn, Zn and Sn as alloying elements. Tests were carried out in simulated Caspian Sea water at 70 C. In the alloy with a magnesium mass fraction of 1.5%, the pitting appeared after a long incubation period and then deepened quickly. The pitting in the alloy with Mg mass fraction of 2% growth was slow and stopped after an exposure of 2,000 hr. Increasing the Mg concentration in the alloy up to 3% of mass fraction reduces its resistance to pit corrosion. Long-term exposure (4,000 hr) caused intercrystalline corrosion in the alloy. Layer corrosion lests show that susceptibility of this Mg alloy to layer corrosion increases with Mg concentrations > 1.5% of mass fraction. Al-Mg alloys with chrome as the alloying element are less susceptible to pitting and general corrosion and simultaneously increases resistance to pit corrosion. (Lantz-PTT) neously inci (Lantz-PTT) W90-07462

8I. Fisheries Engineering

DURING THE FIRST DECADE OF A SUBAL-PINE, MAN-MADE RESERVOIR. Trondheim Univ. Observation 1981 Trondheim Univ. (Norway). Museum. For primary bibliographic entry see Field 2H. W90-06599

PHYSICAL HABITAT SELECTION BY BROWN TROUT (SALMO TRUTTA) IN RIVER-INE SYSTEMS Norges Landbrukshoegskole, Aas. Dept. of Nature Conservation.
For primary bibliographic entry see Field 2H.
W90-06600

ESTIMATING THE NUMBER OF SPECIES AND RELATIVE ABUNDANCE OF FISH IN OLIGOTROPHIC SWEDISH LAKES USING MULTI-MESH GILLNETS. Institute of Freshwater Research, Drottningholm

For primary bibliographic entry see Field 5G. W90-06601

SURVIVAL AND GROWTH TO REPRODUCTIVE MATURITY OF COHO SALMON FOLLOWING EMBRYONIC EXPOSURE TO A MODEL TOXICANT.
Washington Univ., Seattle. School of Fisheries. For primary bibliographic entry see Field 5C. W90-06637

OCEANIC AND RIVERINE INFLUENCES ON VARIATIONS IN YIELD AMONG ICELANDIC STOCKS OF ATLANTIC SALMON. Iowa State Univ., Ames. Dept. of Animal Ecolo-

For primary bibliographic entry see Field 2H.

SPAWNING HABITAT AND REDD CHARAC-TERISTICS OF SOCKEYE SALMON IN THE GLACIAL TAKU RIVER, BRITISH COLUMBIA AND ALASKA. National Marine Fisheries Service, Auke Bay, AK.

Auke Bay Lab. For primary bibliographic entry see Field 2H. W90-06741

FACTORS AFFECTING FISH SPECIES RICHNESS IN ONTARIO LAKES. Bayfield Inst., Burlington (Ontario). For primary bibliographic entry see Field 2H. W90-06743

STRONTIUM:CALCIUM CONCENTRATION RATIOS IN OTOLITHS OF HERRING LARVAE AS INDICATORS OF ENVIRONMEN-TAL HISTORIES.

Hawaii Inst. of Geophysics, Honolulu. Oceanic Biology Div. For primary bibliographic entry see Field 7B. W90-06797

PHYSIOLOGICAL RESPONSES OF JUVE-NILE WHITE MULLET, MUGIL CUREMA, EX-POSED TO BENZENE Instituto Venezolano Tecnologico del Petroleo, Caracas. Dept. of General Engineering.
For primary bibliographic entry see Field 5C.
W90-07030

SUBLETHAL EFFECTS OF MALATHION ON CHANNEL CATFISH, ICTALURUS PUNCTA-Auburn Univ., AL. Dept. of Fisheries and Allied

Aquacultures.
For primary bibliographic entry see Field 5C.
W90-07031

EFFECT OF ENDOSULFAN ON ACID AND ALKALINE PHOSPHATASE ACTIVITY IN LIVER, KIDNEY, AND MUSCLES OF CHANNA GACHUA. Jiwaji Univ., Gwalior (India). School of Studies in

Botany. For primary bibliographic entry see Field 5C. W90-07032

CALMODULIN CONCENTRATION IN MUCUS OF RAINBOW TROUT, SALMO GAIRDNERI, EXPOSED TO COMBINATIONS OF ACID, ALUMINUM, AND CALCIUM. Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5C.
W90-07033

LEVELS OF HEAVY METALS AND ORGAN-CHLORINE PESTICIDES OF CYPRINID FISH REARED FOUR YEARS IN A WASTEWATER TREATMENT POND. 'Adour-Garonne' Water Authority, 90 rue du Fer-

Secondary Publication And Distribution—Group 10C

etra, 31078 Toulouse, France, For primary bibliographic entry see Field 5B. W90-07035

HEAVY METAL CONCENTRATIONS IN THE BANANA PRAWN, PENAEUS MERGUIENSIS, AND LEADER PRAWN, P. MONODON, IN THE TOWNSVILLE REGION OF AUSTRALIA. James Cook Univ. of North Queensland, Towns-ville (Australia). Graduate School of Tropical Veterinary Science.

For primary bibliographic entry see Field 5B. W90-07038

METABOLITES OF THREE STRUCTURAL ISOMERS OF BUTYLBENZENE IN THE BILE OF RAINBOW TROUT.

Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch. For primary bibliographic entry see Field 5B. W90-07039

CHRONIC EFFECTS OF LOW PH ON LENGTH AND WEIGHT OF ATLANTIC SALMON SALMO SALAR.

Maine Cooperative Fish and Wildlife Research Unit, Orono

For primary bibliographic entry see Field 5C. W90-07094

TEMPORAL AND SPATIAL PATTERNS IN LITTORAL-ZONE FISH ASSEMBLAGES OF A RESERVOIR (LAKE TEXOMA, OKLAHOMA-TEXAS, USA).

Oklahoma Univ., Kingston. Biological Station. For primary bibliographic entry see Field 2H. W90-07095

CHANGES IN THE FISH POPULATION OF THE INTERMITTENTLY CLOSED TISZA-DEAD-ARM.

Miksa Deri Machine Industrial Secondary School

Szeged, Hungary.
For primary bibliographic entry see Field 5C.
W90-07121

GROWTH OF CARP (CYPRINUS CARPIO L.) IN THE KISKORE STORAGE LAKE.

Lajos Kossuth Univ., Debrecen (Hungary) A. Harka.

Tiscia TSCAB8, Vol. 24, p 79-86, 1989. 3 fig, 3 tab,

Descriptors: *Carp, *Fish growth, *Fish physiology, *Kiskore Storage Lake, *Nutrient concentrations, *Population dynamics, *Tisza River, Biomass, Czechoslovakia, Danube River, Yugoslavia.

The growth of wild carp in the Kiskore storage lake established in 1978 at the Tisza river has been lake established in 1978 at the 1 isza river has been studied, and compared with data obtained in the Orava storage lake (Czechoslovakia), Danube (Yugoslavia) and Koros Backwater reservoir. The most significant differences were found in comparimost significant differences were found in comparison with carp from the Koros backwater reservoir. Initially the body mass of carp from the Tisza storage lake is smaller but the growth rate is higher, similar tendency is observed in the longitudinal growth. Carp from the storage lake at the age of five years reach the same length as 7-year-old. of the years reach the same length as '-year-old specimens from the Koros backwater reservoir, and except for the first year, their condition is also better. Most probably the rich nutrient supply of the storage lake is of decisive importance for the faster growth and better condition. Positive and naster growth and better condition. Positive and negative deviations were observed as compared to the Czech and Yugoslavian data as well but those were less significant. Growth of carp in the Kiskore storage lake, though essentially more favorable than that in the Koros backwater reservoir, cannot be qualified as outstanding, but only as satisfactory for the circumstances. (Author's abstract) W90-07122

SIDE-SCAN SONAR MAPPING OF LAKE TROUT SPAWNING HABITAT IN NORTHERN LAKE MICHIGAN.

National Fisheries Research Center-Great Lakes, Ann Arbor, MI. For primary bibliographic entry see Field 7B.

WALLEYE SPAWNING HABITAT IN POOL 13 OF THE UPPER MISSISSIPPI RIVER.

Iowa Dept. of Natural Resources, Bellevue. Bellevue Research Station.

North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 3, p 303-308, Summer 1989. 3 fig, 2 tab, 21 ref. Federal Aid in Fish Restoration Project F-96-R.

Descriptors: *Fish behavior, *Mississippi River, *Rivers, *Spawning, *Walleyes, Aquatic habitats, Fish eggs, Fish management, Fish populations, Radiometry, Radiotelemetry, Stizostedion, Sub-

Continued development in the upper Mississippi River may pose a threat to critical fish habitats. This study identified spawning habitat for walleyes stizostedion vitreum so those areas could be af-forded protection from future alterations. Radiotelemetry, egg collections, and the presence of sexu-ally mature fish were used to identify walleye spawning sites in Pool 13 of the upper Mississippi River. Over 2000 walleye eggs were collected in drift nets at two sites from 1983 through 1986. drift nets at two sites from 1983 through 1986. Substrates at spawning sites comprised sand, gravel, and cobble and included a freshwater mussel bed at one location. Water depths at spawning sites ranged from 0.6 to 6.1 m, and the current velocity ranged from 42.7 to 115.8 cm/second during 1986. Most walleye eggs were collected in April within 2 weeks of peak discharges when water temperatures were 8.3-12.2 C. Both spawning sites were adjacent to the navigation channel. (Author's abstract) W90-07180

DOWNSTREAM MIGRATION OF RECENTLY METAMORPHOSED SEA LAMPREYS IN THE OCQUEOC RIVER, MICHIGAN, BEFORE AND AFTER TREATMENT WITH LAMPRICIDES. Fish and Wildlife Service, Millersburg, MI. Hammond Bay Biological Station.
L. H. Hanson, and W. D. Swink.

North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 3, p 327-331, Summer 1989. 1 fig, 2 tab, 14 ref.

Descriptors: *Chemical treatment, *Eel, *Fish management, *Lakes, *Lamprey, *Lampricides, *Michigan, Lake Huron.

The effectiveness of chemical treatments of the Ocqueoc River, Michigan, in reducing the number of recently metamorphosed sea lampreys Petromyzon marinus migrating to Lake Huron and the total numbers of migrants produced before and after treatment was determined. Sea lampreys were captured during their downstream migration in a single fyke net fished in the same location from September 1963 through August 1975. The catch, which averaged 3474 sea lampreys (range: 3248-3913) during four migration periods (September-June) before treatment in 1968, declined to 4 during the 1974-1975 migration period. Mark-recapture studies were conducted to determine the capture efficiency of the net for recently metamorphosed sea lampreys and to estimate the total downstream migration for each migration period. Estimated downstream migrations before treatment of chemical treatments of the downstream migration for each migration period. Estimated downstream migrations before treatment averaged 62,036 sea lampreys (range: 58,000-69,875) for four migration periods and declined to 71 during the 1974-1975 migration period. Catches were usually greater in fall than in spring. The fall peak in migratory activity was in November or December, and the spring peak was in April; both peaks occurred while water levels were high and water temperatures were near 5 C. (Author's abstract) W90-07181

RELATIONS OF PHYSICAL HABITAT TO ABUNDANCE OF FOUR NONGAME FISHES IN HIGH-PLAINS STREAMS: A TEST OF HABITAT SUITABILITY INDEX MODELS. Wyoming Cooperative Fishery and Wildlife Re-search Unit, Laramie. W. A. Hubert, and F. J. Rahel.

North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 3, p 332-340, Summer 1989.

Descriptors: *Chubs, *Fish behavior, *Fish populations, *Habitats, *Stream fisheries, *Sucker, *Wyoming, Biomass, Dace, Fish, Shiner, Streams, Wildlife habitats.

The relations between habitat variables and biomasses of white sucker Catostomus commersoni, creek chub Semotilus atromaculatus, longnose dace Rhinichthys cataractae, and common shiner Notropis cornutus from data collected at 29 sites in the Horse Creek drainage of eastern Wyoming were examined. Few of the habitat variables that have been used in habitat suitability index models were correlated with the biomass of the four species. Also, composite habitat suitability index scores were not correlated with the biomass of the four species. However, abundances of these species were related to other habitat features that were measured and analyzed by correlation and multiple-regression analysis. White sucker biomass was correlated with main-channel run habitat, shade, turbidity, water temperature in August, and large woody debris. Creek chub biomass was related to the coefficient of variation (Standard deviation/mean) in current velocity and to submerged aquatmean) in current velocity and to submerged aquatic vegetation, average current velocity, and main-channel pool habitat. Longnose dace biomass was primarily related to submerged aquatic vegetation, main-channel run habitat, and overhead cover features, and the common shiner, which occurred over only a limited range of stream conditions, was associated with submerged aquatic vegetation, backwater pool habitat, and the amount of silt substrate. (Author's abstract) mean) in current velocity and to submerged aquat-

EFFECTS OF WATER TEMPERATURE ON THE MORTALITY OF FIELD-COLLECTED FISH MARKED WITH FLUORESCENT PIG-

National Fisheries Research Center, La Crosse, WI.

For primary bibliographic entry see Field 7B. W90-07183

RESTORATION OF FISH COMMUNITIES OF THE RHINE RIVER TWO YEARS AFTER A HEAVY POLLUTION WAVE.

Forschungsinstitut und Natur-Museum Sencken-berg, Frankfurt am Main (Germany, F.R.). For primary bibliographic entry see Field 5C. W90-07335

DEVELOPMENT OF CRITICAL LIFE STAGE ASSAYS: TERATOGENIC EFFECTS OF ASH BASIN EFFLUENT COMPONENTS ON FRESHWATER FISH, GAMBUSIA AFFINIS

AND DAPINIA.
Voorhees Coll., Denmark, SC.
For primary bibliographic entry see Field 5C.
W90-07463

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

BEST DEMONSTRATED AVAILABLE TECH-NOLOGY (BDAT) FOR POLLUTION CON-TROL AND WASTE TREATMENT (APR 75 -

National Technical Information Service, Spring-For primary bibliographic entry see Field 5D.

Field 10—SCIENTIFIC AND TECHNICAL INFORMATION

Group 10C—Secondary Publication And Distribution

W90-07472

WASTEWATER TREATMENT (DEC 87 - JUL 89). National Technical Information Service, Spring-For primary bibliographic entry see Field 5D. W90-07473

HORSE MESA DAM, MARICOPA COUNTY, ARIZONA: PHOTOGRAPHS, WRITTEN HIS-TORICAL AND DESCRIPTIVE DATA, RE-DUCED COPIES OF DRAWINGS.

Salt River Project, Phoenix, AZ.
For primary bibliographic entry see Field 6G.
W90-07496

MORMON FLAT DAM, MARICOPA COUNTY, ARIZONA: PHOTOGRAPHS, WRITTEN HISTORICAL AND DESCRIPTIVE DATA, REDUCED COPIES OF DRAWINGS.
Salt River Project, Phoenix, AZ.
For primary bibliographic entry see Field 6G.

W90-07497

DREDGING: BIOLOGICAL EFFECTS (JAN 79 -JUL 1989). National Technical Information Service, Spring-For primary bibliographic entry see Field 6G. W90-07501

10F. Preparation Of Reviews

IMPACT OF TIMBER HARVESTING AND PRODUCTION ON STREAMS: A REVIEW. Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology. For primary bibliographic entry see Field 4C. W90-06659

RAW WATER QUALITY CONTROL: AN OVERVIEW OF RESERVOIR MANAGEMENT TECHNIQUES. Ecosystem Consulting Service, Inc., Coventry,

For primary bibliographic entry see Field 5G. W90-06728

PREPARATION OF AQUEOUS MEDIA FOR AQUATIC TOXICITY TESTING OF OILS AND OIL-BASED PRODUCTS: A REVIEW OF THE PUBLISHED LITERATURE. Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.

For primary bibliographic entry see Field 5C. W90-06766

REVIEW OF THE ROLE OF THE PHYSICO-CHEMICAL ENVIRONMENT IN THE PRO-DUCTION OF CERTAIN FLOC PROPERTIES. Kansas State Univ., Manhattan. Dept. of Chemical Engineering. For primary bibliographic entry see Field 5F. W90-07224

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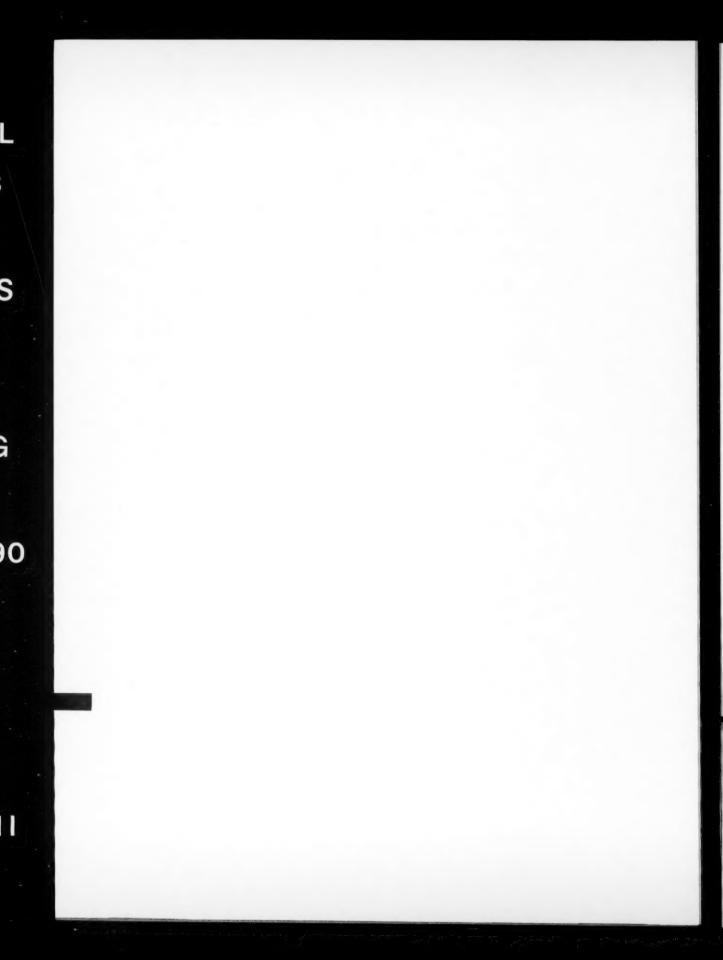
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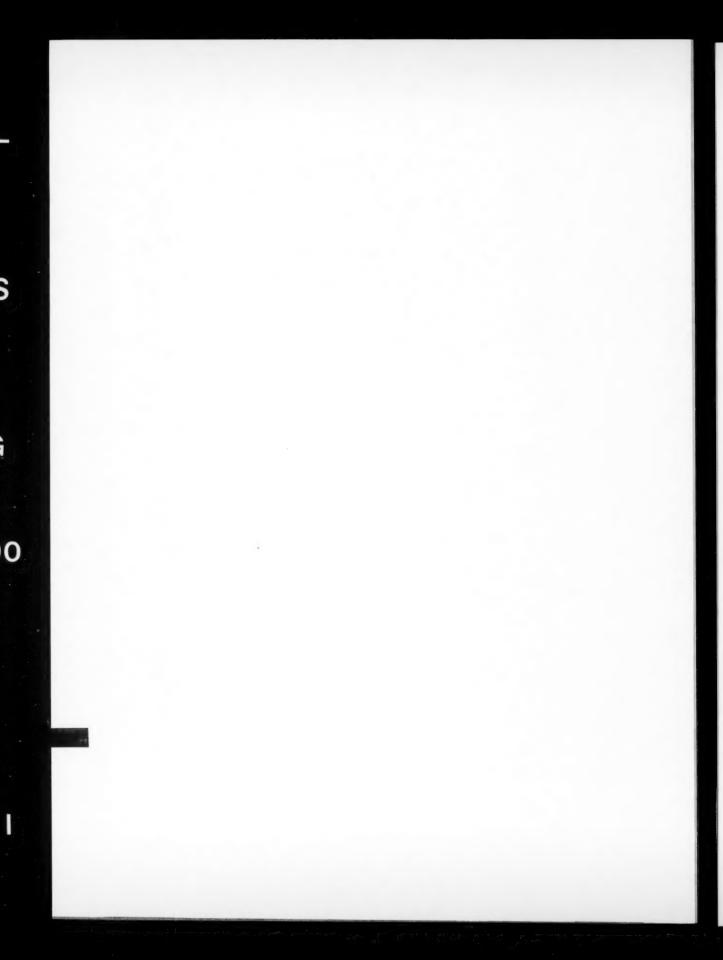
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	Sewage and Sewage Effluents.	the Intertidal Fauna: Part 1. The Effects of
Simultaneous Water and Solute Movement Through an Unsaturated Soil Following an In-	W90-06722 5D	Prolonged Emersion. W90-06639 6G
crease in Recharge. W90-06904 2G	CONSULTING ENGINEER, 2530 ETNA	
	STREET, BERKELEY, CALIFORNIA 94704. Trends in Freshwater Inflow to San Francisco	Expected Effects of the Use of the Oosters- chelde Storm Surge Barrier on the Survival of
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION,	Bay from the Sacramento-San Joaquin Delta.	the Intertidal Fauna: Part 2. The Effects of
GRIFFITH (AUSTRALIA).	W90-06827 2E	Protracted Tidal Cycles. W90-06640 6G
Use of a Thermal Scanner Image of a Water Stressed Crop to Study Soil Spatial Variability.	CONSULTING ENGINEER, INC.,	
W90-06737 2G	WESTWOOD, MA. Contemporary Telemetering Methods for Water	DENVER UNIV., CO. DEPT. OF GEOLOGY AND GEOGRAPHY.
COMMONWEALTH SCIENTIFIC AND	Works Facilities.	Synoptic Climatology of the Bimodal Precipita-
INDUSTRIAL RESEARCH ORGANIZATION,	W90-06729 7B	tion Distribution in the Upper Midwest. W90-07075 2B
NORTH RYDE (AUSTRALIA), DIV, OF COAL TECHNOLOGY,	CONSULTING ENGINEERS, P.O. BOX 223,	
Column Leaching of Unretorted and Retorted	HELIOPOLIS, CAIRO, EGYPT.	DEPARTMENT OF CHEMICAL ENGINEERING, TRIPOLI GSPLAG, LIBYA.
Oil Shales and Claystones from the Rundle De- posit: Water Leaching.	Optimization of Dual-Purpose Steam Power and MSF Desalination Plant.	Experience with Desalination Plants in Libya.
W90-07414 5B	W90-06567 3A	W90-07456 3A

DESALINATION SYSTEMS, INC.,

NORTH VANCOUVER (BRITISH

Desal-5 Membrane for Water Softening.

DILLINGHAM CONSTRUCTION LTD.,

DOW CHEMICAL CO., MIDLAND, MI.

ENVIRONMENTAL SCIENCES RESEARCH

Method for the Determination of 2,3,7,8-Te-Trachlorodibenzo-p-Dioxin in Processed
Wastewater at the Parts per Quadrillion Level.
W90-06750
5A

Construction of the Iona Outfall Submarine Sec-

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W90-06858

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LYON (FRANCE), LAB. D'ECOTOXICOLOGIE.

ESCONDIDO, CA.

W90-06562

COLUMBIA).

W90-07237

LAB.

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In Vivo Effect of the Organophosphorus Insecti-

ECOLE NATIONALE SUPERIEURE DES

ECOLE NATIONALE VETERINAIRE DE

MINES DE PARIS, FONTAINEBLEAU

(FRANCE). CENTRE D'INFORMATION

DEPARTMENT OF ENERGY, WASHINGTON, DC. OFFICE OF ENERGY RESEARCH.

DEPARTMENT OF ENERGY, WASHINGTON,

Subsurface Science Program. Program Overview and Scope: Overview of the Scientific

Scope, Goals and Relevance of Fundamental

Research in Subsoils, Groundwater and Chemi-

cal Contamination Sponsored by the U.S. De-

Evaluation of Mid-to-Long Term Basic Research for Environmental Restoration: Preliminary Analysis to Characterize DOE Waste Prob-

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DEPARTMENT OF FISHERIES AND

DC. OFFICE OF ENERGY RESEARCH.

partment of Energy. W90-07485

fy Research Needs. W90-07486

OCEANS, BURLINGTON (ONTARIO). GREAT	W90-06750 5A	cide Trichlorphon on the Immune Response of
LAKES LAB. FOR FISHERIES AND	DOW CHEMICAL U.S.A., MIDLAND, MI.	Carp (Cyprinus carpio). I. Effect of Contamina-
AQUATIC SCIENCES.	MAMMALIAN AND ENVIRONMENTAL	tion on Antibody Production in Relation to Res-
Probing Ecosystem Health: A Multi-Discipli-	TOXICOLOGY RESEARCH LAB.	idue Level in Organs.
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W90-07256 5A	Butoxyethyl Ester in Coho Salmon. W90-07087 5C	
Is the 'Microbial Loop' an Early Warning Indi-	W 90-07087	ECOSYSTEM CONSULTING SERVICE, INC.,
cator of Anthropogenic Stress.	DREXEL UNIV., PHILADELPHIA, PA.	COVENTRY, CT. Raw Water Quality Control: An Overview of
W90-07263 5A	ENVIRONMENTAL STUDIES INST. Modelling the Environmental Distribution of	Reservoir Management Techniques.
Early Warning Assays: An Overview of Toxici-	Nonpolar Organic Compounds: The Influence of	W90-06728 5G
ty Testing with Phytoplankton in the North American Great Lakes.	Dissolved Organic Carbon in Overlying and In-	EHIME UNIV., MATSUYAMA (JAPAN).
W90-07270 5A	terstitial Water.	DEPT. OF ENVIRONMENT CONSERVATION.
W 30-01210	W90-06761 5B	Contribution of Dissolved Calcium and Magne-
New Standardized Sediment Bioassay Protocol	DU PONT DE NEMOURS (E.I.) AND CO.,	sium to Phytoplanktonic Particulate Phosphorus
Using the Amphipod Hyalella azteca (Saussure).	WILMINGTON, DE. AGRICULTURAL	Concentration at the Heads of Two River Reser-
W90-07290 5A	PRODUCTS DEPT.	voirs.
	Fate of Monocrotophos in the Environment.	W90-06592 2H
In Situ Bioassessment of Dredging and Disposal	W90-07175 5B	
Activities in a Contaminated Ecosystem: Toron-		Polychlorinated Biphenyls (PCBs) in Sediments
to Harbor.	DU PONT DE NEMOURS (E.I.) AND CO.,	in Hong Kong: A Congener-Specific Approach
W90-07308 5C	WILMINGTON, DE. CENTRAL RESEARCH	to the Study of Coplanar PCBs in Aquatic Eco-
THE A DESCRIPTION OF PROPERTY AND	AND DEVELOPMENT DEPT.	systems.
DEPARTMENT OF FISHERIES AND OCEANS, ST. JOHN'S (NEWFOUNDLAND),	Bacterial Production in Freshwater Sediments:	W90-07197 5B
SCIENCE BRANCH.	Cell Specific Versus System Measures. W90-07410 2H	Total Complete Builder
Metabolites of Three Structural Isomers of Bu-	1170-07410	Temporal Trends of Organochlorine Residues in
tylbenzene in the Bile of Rainbow Trout.	DUKE UNIV., DURHAM, NC. SCHOOL OF	Lizard Goby Rhinogobius flumineus from the River Nagaragawa, Japan.
W90-07039 5B	FORESTRY AND ENVIRONMENTAL	W90-07198 5B
	STUDIES.	W90-0/198 3B
DEPARTMENT OF FISHERIES AND	Effects of Complex Waste Mixtures on Hepatic	EL SAIE (M.H.A.), CAIRO (EGYPT).
OCEANS, VANCOUVER (BRITISH	Monooxygenase Activities in Brown Bullheads	Study of the Operating Conditions for Three
COLUMBIA).	(Ictalurus nebulosus).	Large MSF Desalination Units Each of Capacity
Sea Otters and Oil Pollution.	W90-07191 5C	7.2/8.6 MGD (27360/32832 Ton/Day) in Abu
W90-06678 5C	E AND S COMPUTER SYSTEMS, INC.,	Dhabi, UAE.
	SPARTA, NJ.	W90-07445 3A
DEPARTMENT OF FISHERIES AND	Need for Computer-Assisted Hydrography.	
OCEANS, VANCOUVER (BRITISH COLUMBIA). WEST VANCOUVER LAB.	W90-07103 7C	ENVIRONMENT CANADA, MONTREAL
In Situ and Laboratory Studies on the Behavior		(QUEBEC).
and Survival of Pacific Salmon (genus Oncor-	E AND S ENVIRONMENTAL CHEMISTRY,	Bioassay Responses of Micro-Organisms to Sedi-
hynchus).	INC., CORVALLIS, OR.	ment Elutriates from the St. Lawrence River
W90-07301 5C	Variation in Adirondack, New York, Lakewater	(Lake St. Louis).
	Chemistry as Function of Surface Area.	W90-07278 5A
DEPARTMENT OF FISHERIES AND	W90-06833 2K	
OCEANS, WINNIPEG (MANITOBA).	EAST CAROLINA UNIV., GREENVILLE, NC.	ENVIRONMENTAL AND CHEMICAL
FRESHWATER INST.	DEPT OF GEOGRAPHY AND PLANNING	SCIENCES, INC., AIKEN, SC. Steel Creek Water Quality: L Lake/Steel Creek
Bioassays with a Floating Aquatic Plant (Lemna	Nonpoint Source Pollution Risk Assessment in a	Biological Monitoring Program, November
minor) for Effects of Sprayed and Dissolved	Watershed Context.	1985-December 1987.
Glyphosate.	W90-06612 5B	W90-07470 5B
W90-07281 5C		W 70-01410
DEPARTMENT OF SCIENTIFIC AND	EBASCO SERVICES, INC., CHICAGO, IL.	ENVIRONMENTAL ASSESSMENT REVIEW
INDUSTRIAL RESEARCH, CHRISTCHURCH	Extraction of TCE-Contaminated Ground	OFFICE, HULL (QUEBEC).
(NEW ZEALAND), HYDROLOGY CENTRE,	Water by Subsurface Drains and a Pumping Well.	Environmental Impact Assessment: The Grow-
One-Dimensional Flow over a Plane: Criteria	W90-07011 5G	ing Importance of Science in Government Deci-
for Kinematic Wave Modelling.	***************************************	sion Making.
W90-06885 2E	ECOLE NATIONALE SUPERIEURE DES	W90-07259 6A
	MINES DE PARIS, FONTAINEBLEAU	
DEPARTMENT OF THE ENVIRONMENT,	(FRANCE).	ENVIRONMENTAL PROTECTION AGENCY,
		BOSTON, MA. WATER SUPPLY BRANCH.
SAINTE-FOY (QUEBEC).	Modeling Fracture Flow with a Stochastic Dis-	
SAINTE-FOY (QUEBEC). Round Robin Testing with the Selenastrum ca	crete Fracture Network: Calibration and Valida-	Granulated Activated Carbon Water Treatment
SAINTE-FOY (QUEBEC).	crete Fracture Network: Calibration and Valida- tion: 1. The Flow Model.	

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. GC/MS Identification of Mutagens in Aqueous	ENVIRONMENTAL PROTECTION SERVICE, DARTMOUTH (NOVA SCOTIA). MARINE ENVIRONMENTAL BRANCH.	FISH AND WILDLIFE SERVICE, MILLERSBURG, MI. HAMMOND BAY BIOLOGICAL STATION,
Chlorinated Humic Acid and Drinking Waters Following HPLC Fractionation of Strong Acid	Role and Application of Environmental Bioas- say Techniques in Support of the Impact Assess-	Downstream Migration of Recently Metamor- phosed Sea Lampreys In the Ocqueoc River,
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Adsorption Capacity of GAC for Synthetic Or-	W90-07307 5E	W90-07181 8I
ganics. W90-07330 5F	ENVIRONMENTAL PROTECTION SERVICE, REGINA (SASKATCHEWAN). WATER	FISHERIES RESEARCH INST., SZARVAS
ENVIRONMENTAL PROTECTION AGENCY,	QUALITY BRANCH. Assessing Toxicity of Lake Diefenbaker (Sas-	(HUNGARY). Macrozoobenthos in the River Tisza and Its
CINCINNATI, OH. OFFICE OF RESEARCH AND DEVELOPMENT.	katchewan, Canada) Sediments Using Algal and Nematode Bioassays.	Influents. W90-07116 5C
Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to	W90-07276 5A	FLOOD ENGINEERS, JACKSONVILLE, FL.
Marine and Estuarine Organisms. W90-07505 5C	ENVIRONMENTAL RESEARCH LAB., DULUTH, MN.	Simple Approach to Dechlorination.
ENVIRONMENTAL PROTECTION AGENCY,	Simple Flow-Limited Model for Exchange of	W90-06997 5D
CINCINNATI, OH. RISK REDUCTION ENGINEERING LAB.	Organic Chemicals at Fish Gills. W90-06775 5B	FLORIDA INTERNATIONAL UNIV., MIAMI. DRINKING WATER RESEARCH CENTER.
Reduction in Bacterial Densities of Wastewater Solids by Three Secondary Treatment Process-	ENVIRONMENTAL RESEARCH LAB	Abiotic Transformation of Halogenated Organic
es. W90-06842 5D	NARRAGANSETT, NEWPORT, OR. MARK O. HATFIELD MARINE SCIENCE CENTER.	Compounds: II. Considerations During Water Treatment.
ENVIRONMENTAL PROTECTION AGENCY,	Determination of the Ventilation Rates of Inter- stitial and Overlying Water by the Clam	W90-06909 5B
SEATTLE, WA. REGION X. Coeur d'Alene Basin - EPA Water Quality	Macoma nasuta. W90-06780 5B	FLORIDA STATE UNIV., TALLAHASSEE. Relationship Between California Rainfall and
Monitoring, 1972-1986. W90-07504 5G	Method for Determining Gut Uptake Efficien-	ENSO Events.
ENVIRONMENTAL PROTECTION AGENCY,	cies of Hydrophobic Pollutants in a Deposit- Feeding Clam.	
WASHINGTON, DC. OFFICE OF DRINKING WATER.	W90-06781 5B	FLORIDA STATE UNIV., TALLAHASSEE, DEPT. OF METEOROLOGY.
Development of the Revised Drinking Water Standard for Chromium. W90-06698 5G	Comparison of Aqueous and Solid-Phase Uptake for Hexachlorobenzene in the Tellinid Clam	Radiative Transfer to Space Through a Precipi- tating Cloud at Multiple Microwave Frequen- cies. Part III. Influence of Large Ice Particles.
ENVIRONMENTAL PROTECTION AGENCY,	Macoma nasuta (Conrad): A Mass Balance Approach.	W90-06724 7B
WASHINGTON, DC. OFFICE OF EMERGENCY AND REMEDIAL RESPONSE.	W90-06782 5B	FLORIDA UNIV., GAINESVILLE.
Superfund Record of Decision: Hastings	ENVIRONMENTAL SERVICES, EDMONTON (ALBERTA).	Transformation Kinetics of 1,1,1-Trichloroeth- ane to the Stable Product 1,1-Dichloroethane.
Ground Water/Colorado Ave., NE. W90-06950 5G	Characteristics of Nostocoida limicola and Its Activity in Activated Sludge Suspension.	W90-06910 5B
Superfund Record of Decision: Arkansas City Dump, KS.	W90-06837 5D	FLORIDA UNIV., GAINESVILLE, DEPT. OF
W90-06951 5G	ESSEX UNIV., COLCHESTER (ENGLAND). DEPT. OF BIOLOGY.	FISHERIES AND AQUACULTURE, Assessment of Nutrient Effects and Nutrient
Superfund Record of Decision: Oak Grove Landfill, MN.	Degradation of Digested Sewage Sludge in Marine Sediment-Water Model Systems, and	Limitation in Lake Okeechobee. W90-07202 5C
W90-06952 5G	Fate of Metals.	FLUOR DANIEL, GREENVILLE, SC.
Superfund Record of Decision: Ludlow Sand	W90-06646 5D	Pesticides and PCBs in South Carolina Estu-
and Gravel, NY. W90-06953 5G	Heavy Metals in Water, Sediment and Inverte- brates From Rivers in Eastern England.	aries. W90-06648 5B
Superfund Record of Decision: National Starch,	W90-06770 5B	
NC. W90-06954 5G	EUROPEAN CHEMICAL INDUSTRY	FLUOR DANIEL, INC., IRVINE, CA. Laboratory Verification of the Residual Flow
Superfund Record of Decision: Henderson	ECOLOGY AND TOXICOLOGY CENTRE, BRUSSELS (BELGIUM).	Procedure for Three-Dimensional Free Surface Flow.
Road, PA. W90-07471 5G	Screening of Chemicals for Anaerobic Biodegra- dability.	W90-07355 2F
	W90-06763 5B	FORSCHUNGSINSTITUT UND NATUR-
Superfund Record of Decision: Gurley Pit, AR. W90-07474 5G	EVCON CORP., MINNEAPOLIS, MN. Carrier-Gas Process-A New Desalination and Concentration Technology.	MUSEUM SENCKENBERG, FRANKFURT AM MAIN (GERMANY, F.R.). Restoration of Fish Communities of the Rhine
Superfund Record of Decision: Northside Sani- tary Landfill/Environmental Conservation and	W90-07439 3A	River Two Years after a Heavy Pollution Wave.
Chemical, IN. W90-07475 5G	FINNISH ENVIRONMENTAL RESEARCH	W90-07335 5C
Superfund Record of Decision: Marathon Bat-	GROUP, DAMMVAGEN 6, SF-01600 VANDA, FINLAND.	FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
tery, NY. W90-07487 5G	Physiological Effects in Fish Exposed to Ef- fluents from Mills with Six Different Bleaching	Modeling the Interactions of Al Species, Protons
	Processes. W90-06788 5C	and Ca(2+) with Humic Substances in Acid Waters and Soils.
ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF WATER		W90-06933 5B
REGULATIONS AND STANDARDS. Ambient Water Quality Criteria for 2,3,7,8-Te-	FISH AND WILDLIFE SERVICE, BOZEMAN, MT. FISH TECHNOLOGY CENTER.	Evidence from Algal Bioassays of Seasonal Nu-
trachlorodibenzo-p-dioxin. W90-07466 5G	Effects of Water Reuse on Lake Trout. W90-06808 5C	trient Limitations in Two English Lakes. W90-07268 5A

GARHWAL UNIV., SRINAGAR (INDIA). DEPT. OF ZOOLOGY.

GARHWAL UNIV., SRINAGAR (INDIA). DEPT. OF ZOOLOGY. Seasonal Variation of Certain Oxidation-Reduction Characteristics of the River Bhagirathi	GEOLOGICAL SURVEY, TRENTON, NJ. Problems and Methods Involved in Relating Land Use to Ground-Water Quality. W90-06817 5B	GHENT RIJKSUNIVERSITEIT (BELGIUM). INST. VOOR NUKLEAIRE WETENSCHAPPEN.
(India).		Speciation of Aluminium in Surface Water. W90-07344 2K
W90-07058 5B	Well-Purging Criteria for Sampling Purgeable Organic Compounds.	GIBB (ALEXANDER) AND PARTNERS,
GEOFYZIKA N.E., GEOLOGICKA, BARRANDOV (CZECHOSLOVAKIA).	W90-07016 5A	LONDON (ENGLAND). Designing Safety into Dams.
Surface Geoelectrics for the Study of Ground- water Pollution: Survey Design.	GEOLOGICAL SURVEY, WEST TRENTON, NJ.	W90-06871 8A
W90-06892 7A	Hydrologic Effects of Climate Change in the	GLASGOW UNIV. (SCOTLAND), DEPT, OF
GEOLOGICAL SURVEY, COLUMBUS, OH.	Delaware River Basin. W90-07212 2A	ZOOLOGY.
Simulated Effects of Quarry Dewatering Near a		Mercury Levels in the Plumage of Red-Billed Gulls Larus novaehollandiae scopulinus of
Municipal Well Field. W90-07013 2F	Lead and Cadmium Associated with Saltwater Intrusion in a New Jersey Aquifer System.	Known Sex and Age.
GEOLOGICAL SURVEY, DENVER, CO.	W90-07216 5B	W90-07240 5B
Sediment Concentration Versus Water Dis-	GEORGE WASHINGTON UNIV.,	GOETEBORG UNIV. (SWEDEN). DEPT. OF
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Rivers. W90-06888 2J	SCIENCES. Additions to the Diatoms of Virginia's Inland	Impact of Accumulating Drifting Macroalgae on a Shallow-Water Sediment System: An Experi-
Diffusion and Consumption of Methane in an	Fresh Waters: Lake Barcroft, Fairfax County, Virginia.	mental Study. W90-06736 2L
Unsaturated Zone in North-Central Illinois,	W90-06653 2H	W90-08/36 2L
U.S.A. W90-06890 5B	CEORGIA INCT. OF TECH. ATLANTA	GOETEBORG UNIV. (SWEDEN). DEPT. OF
	GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING.	MARINE MICROBIOLOGY.
Determination of Trace Levels of Herbicides	Direct and Boundary-Only Solutions of Multi-	Biofilm Development on Stainless Steel and PVC Surfaces in Drinking Water.
and Their Degradation Products in Surface and Ground Waters by Gas Chromatography/Ion-	layer Aquifer Systems: Part A. Steady State- Solution.	W90-07427 5F
Trap Mass Spectrometry.	W90-06886 2F	GOVIND BALLABH PANT UNIV. OF
W90-06987 5A	D I.D	AGRICULTURE AND TECHNOLOGY.
Problems of Snowmelt Runoff Modelling for a	Direct and Boundary-Only Solutions of Multi- layer Aquifer Systems: Part B. Unsteady-State	PANTNAGAR (INDIA), DEPT, OF
Variety of Physiographic and Climatic Condi- tions.	Solution.	IRRIGATION AND DRAINAGE ENGINEERING.
W90-07021 2E	W90-06887 2F	Finite Difference Solution of Boussinesq Un-
GEOLOGICAL SURVEY, HARTFORD, CT.	Streamflow Model Using Physically-Based In-	steady-State Equation for Highly Sloping Lands. W90-07323 2F
WATER RESOURCES DIV.	stantaneous Unit Hydrographs. W90-06889 2E	1770-01323
Use of Electromagnetic Methods in Ground- Water Contamination Studies: An Application at		GREAT LAKES FORESTRY RESEARCH
the Sanitary Landfill, Farmington, Connecticut.	GEORGIA UNIV., ATHENS, INST. OF ECOLOGY.	CENTRE, SAULT SAINTE MARIE (ONTARIO).
W90-07488 7B	Metabolic Activity of Size-Fractionated Micro-	Ion Leaching From a Sugar Maple Forest in
GEOLOGICAL SURVEY, MENLO PARK, CA.	bial Plankton in Estuarine, Nearshore, and Con- tinental Shelf Waters of Georgia.	Response to Acidic Deposition and Nitrification. W90-07127 5B
WATER RESOURCES DIV. Retention and Transport of Nutrients in a Third-	W90-06634 2L	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Order Stream: Channel Processes.		GRIFFITH UNIV., NATHAN (AUSTRALIA).
W90-06705 2H	Fluctuations In the Community Composition of Water-Column Protozoa In Two Southeastern	SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
Retention and Transport of Nutrients in a Third-	Blackwater Rivers (Georgia, USA). W90-07149 2H	Effect of Physical Factors on the Vertical Dis-
Order Stream in Northwestern California: Hy- porheic Processes.	W 70-0/147	tribution of Phytoplankton in Eutrophic Coastal Waters.
W90-06706 2H	GEORGIA UNIV., SAPELO ISLAND. MARINE INST.	W90-06660 2L
GEOLOGICAL SURVEY, NASHVILLE, TN.	Sources and Characteristics of Fulvic and	Biomagnification by Aquatic Organisms: A Pro-
WATER RESOURCES DIV.	Humic Acids From a Salt Marsh Estuary. W90-07386 2K	posal. W90-06765 5B
Discharge of Sediment in Channelized Alluvial Streams.		W90-06765 5B
W90-07207 2J	GESELLSCHAFT FUER STRAHLEN- UND UMWELTFORSCHUNG M.B.H. MUENCHEN.	Occurrence and Distribution of Polycyclic Aro-
GEOLOGICAL SURVEY, RESTON, VA.	NEUHERBERG (GERMANY, F.R.).	matic Hydrocarbons in Surface Sediments and Water from the Brisbane River Estuary, Austra-
Semiquantitative X-Ray Diffraction Method to	PROJEKTGRUPPE	lia.
Determine Mineral Composition in Stream Sedi- ments with Similar Mineralogy.	UMWELTGEFAEHRDUNGSPONTENIALE VON CHEMIKALIEN.	W90-07005 5B
W90-06625 7B	Estimation of Releases into Rivers with the	Systematic Procedure for Evaluating Partial
GEOLOGICAL SURVEY, RESTON, VA.	Steady-State Surface Water Model EXWAT Using Dichloromethane.	Areas of Watershed Runoff.
WATER RESOURCES DIV.	W90-06791 5B	W90-07321 2E
Operational GLS Model for Hydrologic Regres- sion.	GEZONDHEIDSRAAD, THE HAGUE	GUAM DEPT. OF PUBLIC HEALTH AND
W90-06902 2E	(NETHERLANDS),	SOCIAL SERVICES, AGANA.
GEOLOGICAL SURVEY, SACRAMENTO, CA.	Environmental Aspects of Phosphate Fertilizer Production in the Netherlands with Particular	Reservoirs and Vehicles of Salmonella Infection on Guam.
Organochlorine Pesticide Residues in Bed Sedi-	Reference to the Disposal of Phosphogypsum.	W90-06605 5B
ments of the San Joaquin River, California. W90-06818 5B	W90-07345 5B	GUELPH UNIV. (ONTARIO), DEPT. OF
11 70-00010 3B	GHENT RIJKSUNIVERSITEIT (BELGIUM).	ENVIRONMENTAL BIOLOGY.
GEOLOGICAL SURVEY, TAMPA, FL.	INST. OF ANIMAL ECOLOGY.	Persistence, Leachability, and Lateral Move- ment of Triclopyr (Garlon) in Selected Canadian
Nutrient Distribution and Variability in the Charlotte Harbor Estuarine System, Florida.	Rapid Lake Mapping Using a Portable Laser Rangefinder.	Forestry Soils.
W90-06824 5B	W90-07154 7B	W90-07176 5B

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. INST. FOR ENVIRONMENTAL STUDIES.

Role of Microbial Metal Resistance and Detoxi- fication Mechanisms in Environmental Bioassay Research.	HEBREW UNIV. OF JERUSALEM (ISRAEL), SEAGRAM CENTRE FOR SOIL AND WATER	HUNTON AND WILLIAMS, RICHMOND, VA. MCL. Noncompliance: Is the Laboratory at
W90-07260 5A	SCIENCES. Potential Use of Deep Aquifers in the Negev Desert, Israel: A Mathematical Model and Its	Fault. W90-07327 5F
GUELPH UNIV. (ONTARIO). DEPT. OF ZOOLOGY.	Numerical Solution. W90-06900 2F	HYDEX, INC., VIENNA, VA. Network Design for Water Supply Forecasting
Holistic Approach to Ecosystem Health Assess-	HEI CINIU INIU (PINI AND) DERF OF	in the West.
ment Using Fish Population Characteristics. W90-07258 5A	HELSINKI UNIV. (FINLAND), DEPT. OF MICROBIOLOGY.	W90-06826 7A
HAECON N.V., GHENT (BELGIUM).	Toxicity and Isolation of the Cyanobacterium Nodularia spumigena from the Southern Baltic	HYDRANAUTICS, SAN DIEGO, CA.
Coastal Zone: Occupance, Management and	Sea in 1986.	THM Precursor Removal and Softening-Ft.
Economic Competitiveness. W90-06686 6F	W90-07144 5C	Myers 12 MGD RO Membrane Plant, Florida USA.
W 90-00000	HEVES COUNTY SERVICE OF PUBLIC	W90-06560 5F
HAMBURG UNIV. (GERMANY, F.R.).	HEALTH AND EPIDEMIOLOGY, EGER	
GEOLOGISCH-PALAEONTOLOGISCHES INST, UND MUSEUM,	(HUNGARY). Changes in the Quality of Water in Lasko	HYDROTECHNIK, SALZBURG (AUSTRIA). 'Design of Compact, Containerized Desalination
Structural Studies of Marine and Riverine	Stream and the Storage Lake Built on It at	Plants' Executed for Ministry of Electricity and
Humic Matter by Chemical Degradation.	Egerszalok.	Water, Kuwait.
W90-07369 7B	W90-07118 5C	W90-06561 3A
Humic Substances in Holocene Sediments of the	HOHENHEIM UNIV., STUTTGART	IDAHO NATIONAL ENGINEERING LAB.,
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	TOWN INC. INC. SINCE CIPED	Diatom Species Composition Along a Thermal Gradient In the Portneuf River, Idaho, USA.
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ECONOMICS. Modeling Water Utilization in Large-Scale Irri-	W90-07284 5B	Kinetics of Inactivation of Giardia lamblia by
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THAT THE AND WEI PADE CANADA	HOUSTON UNIV., TX. DEPT. OF CHEMICAL ENGINEERING.	By-products from Ozonation and Photolytic
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dict Possible Impact by Acidic Deposition.	ESTUARINE AND COASTAL STUDIES.	ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
W90-06935 5B	Effects of Salinity and Temperature on the Tox-	Biodegradation Processes to Make Drinking
HEBREW UNIV. OF JERUSALEM (ISRAEL).	icity of Copper to 1-Day and 7-Day-Old Larvae of Hediste (Nereis) diversicolor (O. F. Muller).	Water Biologically Stable.
DIV. OF MICROBIAL AND MOLECULAR	W90-06787 5C	W90-06926 5F
ECOLOGY.	HUMBOLDT-UNIV. ZU BERLIN (GERMAN	ILLINOIS UNIV. AT URBANA-CHAMPAIGN.
Thymidine Incorporation in Saltern Ponds of Different Salinities: Estimation of In Situ	D.R.). SEKTION BIOLOGIE.	INST. FOR ENVIRONMENTAL STUDIES.
Growth Rates of Halophilic Archaeobacteria	Effect of pH on Copper Toxicity to Blue-Green	Understanding the Response to Environmental
and Eubacteria. W90-07409 2H	Algae. W90-07098 4A	Risk Information. W90-06908 6B
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Oxidation of Phenol on Granular Activated Carbon.	INSTITUT DE RECHERCHE DE L'HYDRO- QUEBEC, VARENNES.	INSTITUTE OF FRESHWATER RESEARCH, DROTTNINGHOLM (SWEDEN).
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voir.	DORTMUND (GERMANY, F.R.).	WALLINGFORD (ENGLAND). Inorganic Aluminium-Hydrogen Ion Relation-
W90-06880 2H	Atmospheric H2O2 Field Measurements in a Tropical Environment: Bahia, Brazil.	ships for Acidified Streams; The Role of Water
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Toxicity of Industrial Effluents. W90-07303 5A	Plant Tissues. W90-06974 5E	W90-06978 5B
IMPERIAL COLL, OF SCIENCE AND		Fluorine Variations in Welsh Streams and Soil
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W90-00/21	ence of Dissolved Humic Substances.	Water Mass Structure and Boundaries in the
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TECHNOLOGY, LONDON (ENGLAND). PUBLIC HEALTH ENGINEERING LAB.	INSTITUT NATIONAL DE LA SANTE ET DE	W90-06709 2L
Optimization of a Two-Phase Anaerobic Diges-	LA RECHERCHE MEDICALE, VILLENEUVE D'ASCQ (FRANCE). MICROBE	Composition and Modification of Water Masses
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INDIAN INST. OF TECH., BOMBAY, DEPT.	INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIOUE, BRUSSELS.	Ephemeral Forest Drainage Ditch as a Source
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INDIAN INST. OF TECH., NEW DELHI. CENTRE FOR RURAL DEVELOPMENT AND	RESEARCH. Trace Metals in Sediments From the Adriatic	INSTITUTE OF TERRESTRIAL ECOLOGY,
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Azolla pinnata R.Br. and Lemna minor L. for Removal of Lead and Zinc from Polluted	W90-07394 5B	Dynamics of Silica in a Shallow, Diatom-Rich Scottish Loch: I. Stream Inputs of the Dissolved
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INDIANA UNIV. AT BLOOMINGTON. DEPT.	tal Tritium and Hydrochemical Data in the Bel-	Dynamics of Silica in a Shallow Diatom-Rich
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INSTITUT DE GEOLOGIE DU BASSIN		AGROBIOLOGICAS DE GALICIA, SANTIAGO
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esses and Behaviour.	ing Wastewater.	Distribution of Organic Nitrogen and Carbon.
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INSTITUTO DE MICROBIOLOGIA	Removing Radium by Adding Preformed Hy-	JOHNS HOPKINS UNIV., BALTIMORE, MD.
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de Bejar (Salamanca, Spain): Return of Bioele- ments in Rainfall.	IOWA UNIV., IOWA CITY, INST. OF	Charges for Urban Runoff: Issues in Implemen-
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ated Hydrocarbons in Mussels From the Spanish Atlantic Coast (Galicia): An Assessment of Pol-	DELBUOY: Ocean Wave-Powered Seawater Reverse Osmosis Desalination System.	fluents in the State of Maryland, USA: Results from One Year of Toxicity Testing.
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INSTITUTO NACIONAL DE LIMNOLOGIA,	Composite/Plastic Seawater Reverse Osmosis	JORDAN UNIV. OF SCIENCE AND
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AMAZONIA, MANAUS (BRAZIL), DEPT. OF ECOLOGY.	Mercury Levels in Total Suspended Matter and	Cenological Relations of Mud Vegetation of a Hypertrophic Lake in Tiszaalpar Basin.
Brazil's Balbina Dam: Environment versus the Legacy of the Pharaohs in Amazonia.	in Plankton of the Mediterranean Basin. W90-07393 5B	W90-07110 2H
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BARCELONA (SPAIN), DEPT. QUIMICA	Life-Tables of Daphnia obtusa (Kurz) Surviving	Fate of Some Crude Oil Residues in Sediments.
ANALITICA.	Exposure to Toxic Concentrations of Chromi-	W90-06744 5B
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Physiological Responses of Juvenile White Mullet, Mugil curema, Exposed to Benzene.	W 90-00030	Kansas Clean Lakes Program, Lake Olathe, City of Olathe, Kansas.
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OG PETROLEUMSTEKNOLOGI A/S, TRONDHEIM (NORWAY).	Preliminary Report on the Atrazine and Molin-	Variable-Rate Pumping Tests for Radially Sym-
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Health Hazard From Water Chlorination.	W90-06751 5B	W90-07358 7E
W90-07374 5F	J.L.B. SMITH INST. OF ICHTHYOLOGY,	KANSAS STATE UNIV., MANHATTAN, DEPT.
INSTYTUT RYBACTWA SRODLADOWEGO,	GRAHAMSTOWN (SOUTH AFRICA).	OF CHEMICAL ENGINEERING.
PIASECZNO (POLAND), ZABIENIEC	Composition, Species Richness and Similarity of Ichthyofaunas in Eelgrass Zostera capensis Beds	Review of the Role of the Physicochemical En-
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cide Trichlorphon on Immune Response of Carp	W90-07247 2L	Properties. W90-07224 5F
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Trichlorphon on Nonspecific Immune Response. W90-06794 5C	QUEENSLAND, TOWNSVILLE (AUSTRALIA). GRADUATE SCHOOL OF TROPICAL	KARLSRUHE UNIV. (GERMANY, F.R.). ENGLER-BUNTE INST.
INTERNATIONAL TECHNOLOGY CORP.,	VETERINARY SCIENCE.	Humic-Like Substances From Landfill Lea
MONROEVILLE, PA.	Heavy Metal Concentrations in the Banana Prawn, Penaeus merguiensis, and Leader Prawn,	chates: Characterization and Comparison With Terrestrial and Aquatic Humic Substances.
First- and Third-Type Boundary Conditions in Two-Dimensional Solute Transport Modeling. W90-07362 5B	P. monodon, in the Townsville Region of Australia.	W90-07385 5E
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BELLEVUE, BELLEVUE RESEARCH	JEFFERSON PARISH DEPT. OF SEWERAGE, HARAHAN, LA.	WASSERWIRTSCHAFT.
STATION. Walleye Spawning Habitat In Pool 13 of the	Progressive Process Control Scheme.	Reliability Concepts in Reservoir Design.
Upper Mississippi River. W90-07180 8I	W90-06998 5D	W90-06812 8A
	JIWAJI UNIV., GWALIOR (INDIA). SCHOOL	KARLSRUHE UNIV. (GERMANY, F.R.). INST.
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IOWA UNIV., IOWA CITY. DEPT. OF CIVIL	DEPT. OF EARTH AND PLANETARY	ZOOLOGISCHES INST. Time Scales for the Recovery Potential of Rive
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Simulations of Lake Alkalinity.	in Great Salt, Mono, and Walker Lakes.	Learned from Smaller Streams.
W90-06855 5B	W90-07009 2J	W90-07337 2F

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KARST WATER RESEARCH INST., TREBINJE (YUGOSLAVIA).

KARST WATER RESEARCH INST., TREBINJE (YUGOSLAVIA).	KEURING VAN ELECTROTECHNISCHE MATERIALEN N.V., ARNHEM	KUWAIT FUND FOR ARAB ECONOMIC DEVELOPMENT, SAFAT.
Influence of Construction on Hydrogeological	(NETHERLANDS), ENVIRONMENTAL DEPT.	Increasing Demand for Desalination.
and Environmental Conditions in the Karst Region, Eastern Herzegovina, Yugoslavia.	Phytomonitoring of Pulverized Fuel Ash Lea- chates by the Duckweed Lemna minor.	W90-07431 3A
W90-07187 6G	W90-07282 5B	KUWAIT INST. FOR SCIENTIFIC
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DEVELOPMENT. Hydrochemistry and Pollution Status of Some	Vertical Distribution of Microbiological and	Automated Analysis of Pumping Tests in Un- confined Aquifers of Semi-Infinite Thickness.
Kashmir Himalayan Lakes. W90-06690 5B	Hydrographic-Chemical Parameters in Different Areas of the Baltic Sea. W90-06732 2L	W90-07020 2F
	W 70-00/32	KUWAIT UNIV., SAFAT, DEPT. OF
KASHMIR UNIV., SRINAGAR (INDIA). DEPT. OF BOTANY.	KING ABDULAZIZ UNIV., JEDDAH (SAUDI	MECHANICAL ENGINEERING.
Phosphorus Load-Concentration Relationship in Lake Dal, a High Altitude Marl Lake in the	ARABIA). COLL. OF ENGINEERING. Prospective of Two Small Water Producing	Technical and Economical Comparison Between Large Capacity MSF and RO Desalting Plants.
Kashmir Himalayas.	Units. W90-07441 3A	W90-06573 3A
	KING ABDULAZIZ UNIV., JEDDAH (SAUDI	Technical Aspects of Reducing Desalting Water
KATHOLIEKE UNIV. LEUVEN (BELGIUM). LAB. FOR LAND MANAGEMENT. Estimating Unsaturated Hydraulic Conductivity	ARABIA). DEPT. OF CHEMICAL ENGINEERING.	Cost by Distillation Methods. W90-06574 3A
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KATHOLIEKE UNIV. LEUVEN (BELGIUM). LAB, OF LAND MANAGEMENT.	KING ABDULAZIZ UNIV., JEDDAH (SAUDI	Technoeconomics of Power/Desalting Cogen- eration Plants in KuwaitA Preliminary Study.
Estimating the Soil Moisture Retention Charac- teristic from Texture, Bulk Density, and Carbon	ARABIA). DEPT. OF MECHANICAL ENGINEERING. Humidity Water Vapour Collection by Absorp-	W90-06566 3A
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	W90-07440 3B	verse Osmosis Systems Design in Kuwait. W90-06572 3A
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Pituitary Response to Cadmium During the Early Development of Tilapia (Oreochromis	Rainfall Interception by Bracken Litter: Rela- tionship Between Biomass, Storage, and Drain-	ANALYTICAL CHEMISTRY. Metals in Coastal Waters of Santa Cruz de Ten-
mossambicus).	age Rate.	erife, Canary Islands.
W90-07086 5C	W90-06899 2I	W90-06647 5B
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(NETHERLANDS). DEPT. OF AQUATIC ECOLOGY AND BIOGEOLOGY.	OF BIOSPHERE SCIENCES. Use of Aquatic Macrophytes as a Bioassay	ENGENHARIA E TECNOLOGIA
Impact of Artificial Ammonium-enriched Rain-	Method to Assess Relative Toxicity, Uptake Ki-	INDUSTRIAL, LISBON (PORTUGAL).
water on Soils and Young Coniferous Trees in a Greenhouse. Part IEffects on the Soils.	netics and Accumulated Forms of Trace Metals. W90-07280 5A	Heavy Metal Detection in the Sediment-Water Components of the Sado Estuary by Multiele-
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(NETHERLANDS). LAB. OF AQUATIC ECOLOGY.	Optimum Design for a Hybrid Desalting Plant. W90-06568 3A	LABORATORIO NACIONAL DE ENGENHARIA E TECNOLOGIA
Impact of Artificial, Ammonium-enriched Rain- water on Soils and Young Coniferous Trees in a	KING SAUD UNIV., RIYADH (SAUDI	INDUSTRIAL, LISBON (PORTUGAL). DEPT.
Greenhouse. Part IIEffects on the Trees.	ARABIA), DEPT. OF CHEMICAL	DE ESTUDOS DE IMPACTE INDUSTRIAL.
W90-07241 5C	ENGINEERING.	Assessment of Industrial Sewage Impacts by Adenylate Energy Charge Measurements in the
KENNEDY/JENKS/CHILTON, INC., SAN	Treated Wastewaters as a Growing Water Re- source for Agriculture Use.	Bivalve Cerastoderma edule.
FRANCISCO, CA. Volume Estimation of Light Nonaqueous Phase	W90-07432 3C	W90-06785 5A
Liquids in Porous Media.	KINNERET LIMNOLOGICAL LAB.,	LAJOS KOSSUTH UNIV., DEBRECEN
W90-07014 5B	TIBERIAS (ISRAEL). Effect of Detrital Addition on the Development	(HUNGARY).
KENNEDY (MICHAEL) CONSULTING	of Nanoflagellates and Bacteria in Lake Kin-	Growth of Carp (Cyprinus carpio L.) in the Kiskore Storage Lake.
ENGINEERS, SPOKANE, WA. Liberty Lake Restoration Project. Completion	neret. W90-06677 2H	W90-07122 8I
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	KONINKLIJK INST. VOOR DE MARINE, DEN HELDER (NETHERLANDS).	LAKEHEAD UNIV., THUNDER BAY (ONTARIO). DEPT. OF BIOLOGY.
KENT STATE UNIV., OH. DEPT. OF BIOLOGICAL SCIENCES.	Valve Movement Response of Mussels: A Tool	Hypothesis Formulation and Testing in Aquatic
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KENTUCKY UNIV., LEXINGTON, DEPT. OF	LIMNOLOGICAL INST.	LAKEHEAD UNIV., THUNDER BAY (ONTARIO). DEPT. OF CIVIL
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Methanogenic Degradation of Ozonation Prod- ucts of Biorefractory or Toxic Aromatic Com-	of Stream Benthos Samples.	Instantaneous Peak Flow Estimation Procedures for Newfoundland Streams.
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G.M.B.H. (GERMANY, F.R.). INST. FUER METEOROLOGIE UND KLIMAFORSCHUNG.	Simultaneous Removal of Fluoride and Phos-	SCIENCES.
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Biphenyls With Marine Humic Substances. W90-06768 5B	tering Pellets of Activated Sludge Ash. W90-06616 5D	taminant Content of Sewage Sludges. W90-06771 5D

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF METEOROLOGY.

LAWRENCE BERKELEY LAB., CA. EARTH SCIENCES DIV.	LOUISIANA STATE UNIV., BATON ROUGE, DEPT. OF FORESTRY AND WILDLIFE	MANITOBA UNIV., WINNIPEG. DEPT. OF CIVIL ENGINEERING.
Integral Method Solution for Diffusion in a	MANAGEMENT.	Effect of pH on Sulfide Toxicity to Anaerobic
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W90-06895 2F	an Outpocketing of the Lower Mississippi River,	W90-06623 5D
LEICESTER UNIV. (ENGLAND),	Louisiana (USA). W90-07158 2H	
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W90-07338 6G	DEPT. OF ZOOLOGY AND PHYSIOLOGY. Meiofaunal Responses to Sedimentation from an	W90-07349 3E
LEITNER AND ASSOCIATES, INC., ELM	Alaskan Spring Bloom: II. Harpaticoid Popula-	MARINE BIOLOGICAL ASSOCIATION OF
GROVE, WI.	tion Dynamics.	THE UNITED KINGDOM, PLYMOUTH
Costs of Seawater Desalination in Real Terms,	W90-06632 2L	(ENGLAND).
1979 Through 1989, and Projections for 1999.	LOUISIANA STATE UNIV., BATON ROUGE,	Steady-State Analysis of the 'Microbial Loop' in
W90-06570 3A	LAB. FOR WETLAND SOILS AND	Stratified Systems. W90-06631 2L
LEYLAND CONSULTANTS LTD., AUCKLAND	SEDIMENTS.	W90-00031 2L
(NEW ZEALAND).	Transformations of Selenium As Affected by	Application of Combined Tissue Residue Chem-
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W90-06875 8A	W90-07366 5B	(Mytilus edulis) for the Assessment of Environ-
I IMMOLOCICCU INCT. OOCTEDZEE		mental Pollution.
LIMNOLOGISCH INST., OOSTERZEE (NETHERLANDS). TJEUKEMEER LAB.	LOUISIANA STATE UNIV., BATON ROUGE.	W90-07293 5A
Nitrogen Analyses in Eutrophic Alkaline and	NUCLEAR SCIENCE CENTER. Assessment of Stable Nitrogen Isotopes in Fin-	MARYLAND UNIV., COLLEGE PARK. DEPT.
Peaty Waters: A Comparison of Different Meth-	gerprinting Surface Water Inorganic Nitrogen	OF CIVIL ENGINEERING.
ods to Analyse Ammonia-Nitrogen.	Sources.	Economic Framework for Flood and Sediment
W90-07424 7B	W90-07134 5A	Control with Detention Basins.
LINKOEPING UNIV. (SWEDEN), DEPT. OF	LUND UNIV. (SWEDEN). DEPT. OF ANIMAL	W90-06831 4A
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RESEARCH.	Aluminum Accumulation in a Lotic Mayfly at	Comparison of Activated Sludge Stabilization Under Aerobic or Anoxic Conditions.
Naturally Produced Adsorbable Organic Halo-	Low pHA Laboratory Study.	W90-06840 5D
gens (AOX) in Humic Substances from Soil and	W90-06792 5B	W 90-00040
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	ECOLOGY.	OF GEOGRAPHY.
Properties of Fulvic Acids From Deep Ground-	Transport of Incinerated Organochlorine Com- pounds to Air, Water, Microlayer, and Orga-	Dilution Mixing Estimates of Trace Metal Con- centrations in Suspended Sediments.
waters. W90-07380 2F	nisms.	W90-06966 5A
***************************************	W90-06680 5B	***************************************
LIVERPOOL UNIV. (ENGLAND).	LUND UNIV. (SWEDEN), DEPT, OF WATER	MARYLAND UNIV., SOLOMONS.
OCEANOGRAPHY LAB.	RESOURCES ENGINEERING.	CHESAPEAKE BIOLOGICAL LAB.
Phthalate Ester Speciation in Estuarine Water,	Impact of the Greenhouse Effect on Sewerage	Modeling Coastal Landscape Dynamics.
Suspended Particulates and Sediments. W90-07195 5B	Systems: Lund Case Study.	W90-07136 4C
	W90-07023 5C	MASSACHUSETTS INST. OF TECH.,
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Stability of Aluminum Species in a Natural Audit Sample: Possible Application as a Quality	Environmental Influence of a Volcanic Plume, a	Evaporation from Heated Water Bodies: Pre-
Control Solution.	New Technique of Study, Mount Etna, Sicily. W90-06965 5A	dicting Combined Forced Plus Free Convection.
W90-06932 5B	W 70-00700	W90-06851 2D
	LYONNAISE DES EAUX, LE PECQ	MASSACHUSETTS INST. OF TECH.,
Calmodulin Concentration in Mucus of Rainbow	(FRANCE). LAB. CENTRAL.	CAMBRIDGE, RALPH M. PARSONS LAB.
Trout, Salmo gairdneri, Exposed to Combina- tions of Acid, Aluminum, and Calcium.	Optimization of Sludge Anaerobic Digestion by Separation of Hydrolysis-Acidification and	Colloid Mobilization in Two Atlantic Coastal
W90-07033 5C	Methanogenesis.	Plain Aquifers: Field Studies.
	W90-06614 5D	W90-07359 5E
LOUGHBOROUGH UNIV. OF TECHNOLOGY	MAINE COOPERATIVE FISH AND	ALACCA CHILICENES TATEL AND ENDOY DEED
(ENGLAND), DEPT. OF GEOGRAPHY, Freeze-Coring Technique Applied to Pollution	WILDLIFE RESEARCH UNIT, ORONO.	MASSACHUSETTS UNIV., AMHERST. DEPT. OF ELECTRICAL AND COMPUTER
by Fine Sediments in Gravel-Bed Rivers.	Chronic Effects of Low pH on Length and	ENGINEERING.
W90-07399 5A	Weight of Atlantic Salmon Salmo salar.	Remote Sensing of Clouds and Fog with a 1.4
	W90-07094 5C	mm Radar.
LOUISIANA STATE UNIV., BATON ROUGE.	MAINE UNIV., ORONO. DEPT. OF BOTANY.	W90-06669 2B
CENTER FOR WETLAND RESOURCES. Nitrification and Nitrate Reduction in Bottom	Aluminum Toxicity in Forests Exposed to	Maria
Sediment of Louisiana's Baratarian Basin.	Acidic Deposition: The ALBIOS Results.	MAX-PLANCK-INST, FUER LIMNOLOGIE ZU PLOEN (GERMANY, F.R.).
W90-07079 2L	W90-07125 5B	Herbicide Effects on Planktonic Systems of Dif-
	MALAYA UNIV., KUALA LUMPUR	ferent Complexity.
LOUISIANA STATE UNIV., BATON ROUGE.	(MALAYSIA). DEPT. OF CHEMICAL	W90-07289 5A
DEPT. OF AGRICULTURAL ECONOMICS AND AGRIBUSINESS.	ENGINEERING.	
Farm Program Impacts on an Exhaustible	Performance and Kinetics of an Activated	MCGILL UNIV., MONTREAL (QUEBEC).
Groundwater Supply: An Analysis of the Texas	Sludge System Treating Wastewater Containing Branched Alkylbenzene Sulphonates.	DEPT. OF METEOROLOGY.
Southern High Plains.	W90-06615 5D	Comparison of Several Radiometric Methods of Deducing Path-Integrated Cloud Liquid Water
W90-06845 6D		W00 06667 2E
LOUISIANA STATE UNIV., BATON ROUGE.	MANHATTAN COLL., BRONX, NY. DEPT. OF	11 20-00007
DEPT. OF AGRONOMY.	ENVIRONMENTAL ENGINEERING AND SCIENCE.	Influence of Internal Wave Induced Vertica
Correlation of Spatially Variable Soil Water Re-	Biologically Enhanced Oxygen Transfer in the	Mixing on Ice Algal Production in a Highly
tention for a Surface Soil.	Activated Sludge Process.	Stratified Sound.
W90-06985 2G	W90-06844 5D	W90-07002 2I

MCILVAINE CO., NORTHBROOK, IL.

MCILVAINE CO., NORTHBROOK, IL. New Treatment Schemes Control Odors. W90-07062 5D	MINISTRY OF ELECTRICITY AND WATER, SAFAT (KUWAIT). Recarbonation Process for Treatment of Dis-	MONTGOMERY (JAMES M.) CONSULTING ENGINEERS, INC., PASADENA, CA. Simplified Design of Biofilm Processes Using
MCNEESE STATE UNIV., LAKE CHARLES,	tilled Water Produced by MSF PLants in Kuwait.	Normalized Loading Curves.
LA.	W90-07450 5F	W90-06843 5D
Halogenated Organic Compounds Found in Shrimp From the Calcasieu Estuary. W90-06759 5B	Operational Experience of Once Through MSF Desalination Units.	MONTPELLIER-1 UNIV. (FRANCE), LAB. D'HYDROLOGIE ET D'HYGIENE. Stimulation of Psychrophilic Methanation With
MELBOURNE UNIV., PARKVILLE	W90-07452 3A	a Septic Tank Biological Activator (Stimulation
(AUSTRALIA), DEPT, OF BOTANY, Phenology of the Cladophora-Stigeoclonium Community in Two Urban Creeks of Mel-	MINISTRY OF PUBLIC WORKS, POWER AND WATER, MANAMA (BAHRAIN).	de la Methanisation Psychrophile par un Bioacti- vateur pour Fosse Septique). W90-07421 5D
bourne.	Rehabilitation of Desalination Plants at Sitra	
W90-06657 2H	Power Station, Bahrain. W90-07449 3A	MOSUL UNIV. (IRAQ). SADDAM DAM RESEARCH CENTRE.
MELBOURNE UNIV., PARKVILLE (AUSTRALIA). MARINE CHEMISTRY LAB.		Water Quality Model for the Tigris River
Chemical Properties of a Low-Oxygen Water Column in Port Hacking (Australia): Arsenic,	MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF ECOLOGY AND BEHAVIORAL BIOLOGY.	Downstream of Sadam Dam, Iraq. W90-07025 7C
Iodine and Nutrients. W90-06804 2K	Functional Bioassays Utilizing Zooplankton: A Comparison.	MUNICH UNIV. (GERMANY, F.R.), DEPT. OF
METEOROLOGICAL RESEARCH INST.,	W90-07257 5A	SOIL SCIENCE. Acidic Deposition: Extent and Impact on Forest
YATABE (JAPAN). Doppler Radar Analysis of the Structure of Me-	MINNESOTA UNIV., MINNEAPOLIS.	Soils, Nutrition, Growth and Disease Phenomena in Central Europe: A Review.
soscale Snow Bands Developed Between the Winter Monsoon and the Land Breeze.	LIMNOLOGICAL RESEARCH CENTER. Paleolimnological Evidence for the Recent	W90-07123 5B
W90-07077 2B	Acidification of Lyn Hir, Dyfed, Wales. W90-06671 5C	Effects of Acid Irrigation and Liming in a
METROPOLITAN WATER, SEWERAGE AND	MINNESOTA UNIV., MINNEAPOLIS. ST.	Norway Spruce Stand (Picea abies (L.) Karst). W90-07124 5B
DRAINAGE BOARD, SYDNEY (AUSTRALIA). Recovery of Viruses and Bacteria In Waters Off	ANTHONY FALLS HYDRAULIC LAB.	MUNICH UNIV. (GERMANY, F.R.).
Bondi Beach: A Pilot Study.	Oxygen Demand in Ice Covered Lakes as it Pertains to Winter Aeration.	ZOOLOGISCHES INST.
	W90-07206 2H	Vertical Migration of Chaoborus flavicans (Dip- tera, Chaoboridae): Control of Onset of Migra-
MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF FISHERIES AND WILDLIFE. Benthic Invertebrate Bioassays With Toxic Sedi-	Low-Head Hydropower Impacts on Stream Dis- solved Oxygen.	tion and Migration Velocity by Environmental Stimuli.
ment and Pore Water.	W90-07208 6G	W90-06877 2H
W90-06783 5A	MISSOURI DEPT. OF CONSERVATION, COLUMBIA.	MURDOCH UNIV. (WESTERN AUSTRALIA).
Recent Developments In and Intercomparisons of Acute and Chronic Bioassays and Bioindica-	Impact of a Massive Crude Oil Spill on the Invertebrate Fauna of a Missouri Ozark Stream.	SCHOOL OF ENVIRONMENTAL AND LIFE SCIENCE.
tors. W90-07251 5A	W90-07239 5C	Leachate Quality from Gypsum Neutralized Red Mud Applied to Sandy Soils.
Conditional Stability Constants and Binding Ca-	MISSOURI UNIVCOLUMBIA, DEPT. OF	W90-07217 2G
pacities for Copper (II) by Ultrafilterable Mate- rial Isolated from Six Surface Waters of Wyo-	AGRICULTURAL ECONOMICS. Comparison of Erosion and Water Pollution Control Strategies for an Agricultural Water-	MUSEUME NATIONAL D'HISTOIRE NATURELLE, PARIS (FRANCE), LAB, DE
ming, USA. W90-07313 5B	shed. W90-07350 5G	CRYPTOGAMIE. Hydrocarbon Weathering and Biodegradation in
MID-TISZA REGION WATER	MITSUBISHI HEAVY INDUSTRIES LTD.,	a Tropical Estuarine Ecosystem. W90-06638 5B
CONSERVANCY DIRECTORATE, SZEGED (HUNGARY). WATER CHEMISTRY LAB,	TOKYO (JAPAN). Prevention of the Scale Trouble of Multi-Effects	NAGOYA UNIV. (JAPAN), DEPT, OF
Heavy Metal Content in the Branchiae of Some Tisza River Fish.	Stacked Desalination Plant. W90-07455 3A	CHEMICAL ENGINEERING.
W90-07117 5B		Development and Application of a Roof Type Solar Still.
MIDDLESEX POLYTECHNIC, ENFIELD	MONOSOWSKI ASSOCIATE CONSULTANTS, SIC LTD, SAO PAULO, BRAZIL.	W90-07438 3A
(ENGLAND). URBAN POLLUTION RESEARCH CENTER.	Lessons from the Tucurui Experience. W90-06874 6G	NAGOYA UNIV. (JAPAN). WATER RESEARCH INST.
Sources and Storm Loading Variations of Metal Species in a Gullypot Catchment.	MONSANTO CO., ST. LOUIS, MO.	Nitrogen Budget in the Euphotic Zone of Lake
W90-06980 5B	Amino Acids as Model Compounds for Haloge- nated By-products Formed on Chlorination of	Biwa from Spring to Summer, 1986. W90-06674 2H
MIDWEST RESEARCH INST., CARY, NC. Risk Analysis on Air Emissions from Ground-	Natural Waters. W90-06917 5F	Composition of Photosynthetic Products in
water Aeration. W90-06834 5F	MONTANA STATE UNIV., BOZEMAN. DEPT.	Lake Biwa, Japan; Vertical and Seasonal Changes and Their Relation to Environmental
MIKSA DERI MACHINE INDUSTRIAL	OF BIOLOGY. Rheotaxis of Young Arctic Grayling from Popu-	Factors. W90-06675 2H
SECONDARY SCHOOL SZEGED, HUNGARY. Changes in the Fish Population of the Intermit-	lations that Spawn in Inlet or Outlet Streams of a Lake.	W90-06675 2H NAIROBI UNIV. (KENYA), DEPT, OF
tently Closed Tisza-Dead-Arm. W90-07121 5C	W90-06739 2H	AGRICULTURAL ENGINEERING.
MINISTRY OF AGRICULTURE, FISHERIES	Effect of Long Pools On the Drift of Macro-	Transient Hydraulic Model for Simulating Canal-Network Operation.
AND FOOD, BURNHAM ON CROUCH (ENGLAND), FISHERIES LAB.	Invertebrates In a Mountain Stream. W90-07150 2H	W90-07320 8B
Method for Studying the Impact of Polluted Marine Sediments on Intertidal Colonising Orga-	MONTANA STATE UNIV., BOZEMAN. DEPT. OF MICROBIOLOGY.	NANTES UNIV. (FRANCE), LAB. DE PHYSIOLOGIE.
nisms; Tests with Diesel-Based Drilling Mud and	Microbiology of Granular Activated Carbon	Relationship Between Metals in Sea-Water and
Tributyltin Antifouling Paint. W90-07295 5A	Used in the Treatment of Drinking Water. W90-06925 5A	Metal Accumulation in Shrimps. W90-06682 5B

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).

NAPLES UNIV. (ITALY), DIPT. DI FARMACOLOGIA SPERIMENTALE,	NATIONAL HYDROLOGY RESEARCH INST.,	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ROCKVILLE, MD.
Polycyclic Aromatic Hydrocarbons in Marine	SASKATOON (SASKATCHEWAN). Modelling Water Temperature Beneath River	Summary of Selected Data on Chemical Con-
Organisms from Italian Central Mediterranean	Ice Covers.	taminants in Sediments Collected During 1984,
Coasts.	W90-07235 2H	1985, 1986, and 1987.
W90-06679 5B		W90-07502 5B
Leaching of Mutagens into Mineral Water from	NATIONAL HYDROLOGY RESEARCH INST.,	
Polyethyleneterephthalate Bottles. W99-07346 5B	SASKATOON (SASKATCHEWAN). HYDROMETEOROLOGICAL RESEARCH DIV.	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, WASHINGTON, DC.
	Use of Time Series Analysis to Detect Climatic	CLIMATE ANALYSIS CENTER.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD.	Change. W90-06898 2B	Estimating Climatic-Scale Precipitation from Space: A Review.
GODDARD SPACE FLIGHT CENTER.	W 90-00098 2B	W90-07073 7B
Experimental Tests of Methods for the Measure-	NATIONAL INST. FOR ENVIRONMENTAL	
ment of Rainfall Rate Using an Airborne Dual- Wavelength Radar. W90-06973 2B	STUDIES, IBARAKI (JAPAN). Significance of a Low Oxygen Layer for a	NATIONAL RESEARCH CENTRE, CAIRO (EGYPT). WATER POLLUTION CONTROL
NATIONAL BOARD OF WATERS, HELSINKI	Daphnia Population In Lake Yunoko, Japan. W90-07146 2H	LAB. Response of Freshwater Alga Scenedesmus to Triazine Herbicides.
(FINLAND). Analysis of Humic and Lignin Compounds in	NATIONAL INST. FOR WATER RESEARCH,	W90-07128 5C
the Northern Baltic Sea.	CONGELLA (SOUTH AFRICA), NATAL	
W90-07383 7B	REGIONAL LAB. Fairweather Versus Flood Sedimentation in	NATIONAL SEVERE STORMS LAB., NORMAN, OK.
NATIONAL BOTANICAL RESEARCH INST.,	Mhlanga Lagoon, Natal: Implications for Envi-	Comparison of Simulated Rain Rates from Dis-
LUCKNOW (INDIA), AQUATIC BOTANY LAB.	ronmental Management. W90-07080 2J	drometer Data Employing Polarimetric Radar
Toxicity and Accumulation of Chromium in		Algorithms. W90-06971 2B
Ceratophyllum demersum L.	NATIONAL INST. FOR WATER RESEARCH,	W90-069/1
W90-07037 5D	PRETORIA (SOUTH AFRICA). Aspects of the Phosphorus Cycle in Hartbee-	NATIONAL SWEDISH ENVIRONMENT
NATIONAL CENTER FOR ATMOSPHERIC	spoort Dam (South Africa), Phosphorus Load-	PROTECTION BOARD, SOLNA. RESEARCH
RESEARCH, BOULDER, CO.	ing and Seasonal Distribution of Phosphorus in	DEPT.
Generation and Propagation of a Nocturnal	the Reservoir. W90-06585 2H	Mercury: Occurrence and Turnover of Mercury in the Environment.
Squall Line. Part I: Observations and Implica- tions for Mesoscale Predictability.	W90-06383 2H	W90-07469 5B
W90-06805 2B	Aspects of the Phosphorus Cycle in Hartbee-	
C C I D C I V	spoort Dam (South Africa), Phosphorus Kinet-	NATIONAL TAIWAN UNIV., TAIPEI. DEPT.
Generation and Propagation of a Nocturnal Squall Line. Part II: Numerical Simulations.	ics. W90-06586 2H	OF AGRICULTURAL ENGINEERING.
W90-06806 2B	***************************************	Study of Soil Water Changes in a Peanut Field (in Chinese).
	NATIONAL INST. OF PUBLIC HEALTH,	W90-06905 2G
Evaluation of Liquid Water Measuring Instru- ments in Cold Clouds Sampled during FIRE.	OSLO (NORWAY).	
W90-06970 2B	Major and Trace Elements in Standard and Ref- erence Samples of Aquatic Humic Substances	NATIONAL TAIWAN UNIV., TAIPEL INST.
	Determined by Instrumental Neutron Activation	OF ENVIRONMENTAL ENGIEERING.
NATIONAL CENTRE FOR SCIENTIFIC RESEARCH, HAVANA (CUBA). CHEMISTRY	Analysis (INAA).	Extracting Heavy Metals from Municipal and Industrial Sludges.
DIV.	W90-07371 7B	W90-07343 5D
Trace Analysis of Volatile Chlorination Byprod-	Anion Exchange as a Potential Method for Re-	***************************************
ucts of Aquatic Humic Substances: THMs in Treated Water.	moval of Humus in Drinking Water Treatment.	NATIONAL TECHNICAL INFORMATION
W90-07377 5F	W90-07376 5F	SERVICE, SPRINGFIELD, VA.
Humic Substance Removal Through Surface	Volatile Compounds Associated With Aquatic Humic Substances.	Best Demonstrated Available Technology (BDAT) for Pollution Control and Waste Treat- ment (Apr 75 - Jan 90).
Water Potabilization Processes. W90-07378 5F	W90-07379 2H	W90-07472 5D
W90-07378 5F		
NATIONAL EFFLUENT TOXICITY	Comparison of Molecular Weight Distribution and Acid/Base Properties Between the IHSS	Wastewater Treatment (Dec 87 - Jul 89).
ASSESSMENT CENTER, DULUTH, MN.	Nordic Fulvic Acid and Whole Water Humic	W90-07473 5D
Identifying Toxicants: NETAC's Toxicity-Based Approach.	Substances.	Prodeing Biological Effects (Ion 70 Jul 1980)
W90-06662 5A	W90-07382 2K	Dredging: Biological Effects (Jan 79 - Jul 1989). W90-07501 6G
ALL THE STATE OF T	NATIONAL MARINE FISHERIES SERVICE,	W 20-0/301
NATIONAL FISHERIES CONTAMINANT RESEARCH CENTER, COLUMBIA, MO.	AUKE BAY, AK. AUKE BAY LAB.	NATIONAL UNIV. OF SINGAPORE, DEPT.
Chronic No-Observed-Effect Concentrations of	Spawning Habitat and Redd Characteristics of	
Aluminum for Brook Trout Exposed in Low-	Sockeye Salmon in the Glacial Taku River, Brit- ish Columbia and Alaska.	Effect of Elodea densa on Aquaculture Water Quality.
Calcium, Dilute Acidic Water. W90-06940 5C	W90-06741 2H	W90-07225 5D
W 70-00740		W 30-0,223
NATIONAL FISHERIES RESEARCH	NATIONAL MARINE FISHERIES SERVICE, BEAUFORT, NC. BEAUFORT LAB.	NATIONAL WATER RESEARCH INST.,
CENTER-GREAT LAKES, ANN ARBOR, MI. Side-Scan Sonar Mapping of Lake Trout	Sediment Stabilization by Halophila decipiens in	BURLINGTON (ONTARIO).
Spawning Habitat In Northern Lake Michigan.	Comparison to Other Seagrasses.	Analysis of Aquifer Tests Conducted in Frac- tured Rock: A Review of the Physical Back-
W90-07179 7B	W90-07007 2J	ground and the Design of a Computer Program
NATIONAL FISHERIES RESEARCH	NATIONAL OCEANIC AND ATMOSPHERIC	for Generating Type Curves.
CENTER, LA CROSSE, WI.	ADMINISTRATION, ANN ARBOR, MI.	W90-07019 2F
Effects of Water Temperature On the Mortality	GREAT LAKES ENVIRONMENTAL	Biological Assessment of Contaminated Sadi
of Field-Collected Fish Marked with Fluores-	RESEARCH LAB. Toxicokinetics of PAHs in Hexagenia.	Biological Assessment of Contaminated Sedi mentThe Detroit River Example.
cent Pigment. W90-07183 7B		W90-07294 5A

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). LAKES RESEARCH

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO), LAKES	NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION,	Growth, Photosynthesis and Nitrogen Fixation of Anabaena doliolum Exposed to Assam Crude
RESEARCH BRANCH.	ALBANY.	Extract.
Distribution of Polychlorinated Biphenyls in Water, Sediment and Biota of Two Harbours.	Delaware Park Lake Revitalization Project. W90-07498 5G	W90-07040 5C
W90-06746 5B	NEW YORK STATE DEPT. OF HEALTH,	NORTH WEST WATER AUTHORITY,
Radionuclide Partitioning across Great Lakes Natural Interfaces.	ALBANY, WADSWORTH CENTER FOR LABS, AND RESEARCH.	WARRINGTON (ENGLAND). PLANNING DEPT.
W90-06961 5B	Continuous Culture Algal Bioassays for Organic	Field Hydrogeology.
Common Analytical Errors in the Radiodating of Recent Sediments.	Pollutants in Aquatic Ecosystems. W90-07271 5A	W90-06942 2F
W90-06964 2J	NUMBER OF THE AND CAMPOSITE AD STATED	NOVA SCOTIA AGRICULTURAL COLL.,
NATIONAL WATER RESEARCH INST.,	NEWCASTLE AND GATESHEAD WATER CO., NEWCASTLE UPON TYNE (ENGLAND), Improving Rural Supplies in Northumberland.	TRURO. ENVIRONMENTAL MICROBIOLOGY LAB.
BURLINGTON (ONTARIO), RIVERS RESEARCH BRANCH.	W90-06715 SEPPRES III NOTHIGHIOETIANG.	Importance of Bioassay Volume in Toxicity Tests Using Algae and Aquatic Invertebrates.
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Prawn, Metapenaeus monoceros (Fabricius). W90-06789 5C	W90-06815 8B	Aquatic Macrophyte Studies on Woods Reser- voir, Tennessee.
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ENGINEERING. Analysis of One-Dimensional Solute Transport	Comprehensive Evaluation of the Results of the Daphnia Test Carried Out at the Tisza-Section	TEXAS A AND M UNIV., COLLEGE STATION. COLL. OF GEOSCIENCES.
Through Porous Media with Spatially Variable	and Major District Waters in Szolnok County	Formalism for Comparing Rain Estimation De- signs.
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TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF CHEMISTRY.	TOKYO UNIV. (JAPAN). DEPT. OF GEOGRAPHY.	TSUKUBA UNIV. (JAPAN). INST. OF BIOLOGICAL SCIENCES.
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Mutagenic Potential of Municipal Sewage Sludge Amended Soils.	INST. Phytoplankton Distribution in a Frontal Region of Tokyo Bay, Japan in November 1985.	TSUKUBA UNIV. (JAPAN), SCIENCE INFORMATION PROCESSING CENTER.
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W90-07053 5D	TRACTEBEL S.A., BRUSSELS (BELGIUM). Comprehensive Study on Capital and Operation-	UNDERGROUND INJECTION PRACTICES COUNCIL, OKLAHOMA CITY, OK.
THAMES WATER AUTHORITY, READING (ENGLAND). RIVERS DIV.	al Expenditures for Different Types of Seawater Desalting Plants (RO, MVC, ME, ME-TVC,	California Division of Oil and Gas Underground Injection Control Program: A Peer Review.
Restoration and Enhancement of Engineered River Channels: Some European Experiences.	MSF) Rated Between 200 cubic m/d and 3000 cubic m/d.	W90-07499 5E
W90-07334 4A	W90-06571 3A	UNIVERSIDAD DEL PAIS VASCO, BILBAO
THAYER SCHOOL OF ENGINEERING, HANOVER, NH.	TRANSDUCER RESEARCH, INC., NAPERVILLE, IL.	(SPAIN). LAB. CITOLOGIA-HISTOLOGIA.
Impact of Economic and Financial Policies on the Development of Small-Scale Hydroelectric Facilities in New England.	Mobility of Plutonium and Americium Through a Shallow Aquifer in a Semiarid Region. W90-06993 5B	Laboratory Study of Cadmium Exposure in Lit- torina littorea in Relation the Environmental Cadmium and Exposure Time.
W90-06703 6E	W 90-00993	W90-07341 5A
TOKYO INST. OF TECH. (JAPAN). DEPT. OF	TRENT UNIV., PETERBOROUGH	INVERSIDAD MACIONAL AUTONOMA DE
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Role of Forest Canopies in the Collection and Neutralization of Airborne Acid Substances.	the Otonabee River-Rice Lake System, Peter- borough, Canada.	Formaldehyde Levels in Air and Wet Precipita-
W90-07389 5B	W90-06758 5B	tion at Mexico City, Mexico. W90-07193 5B
TOKYO METROPOLITAN UNIV. (JAPAN).	TRONDHEIM UNIV. (NORWAY), MUSEUM,	
DEPT. OF CHEMISTRY. Biodegradation Experiments of Linear Alkyl-	Crustacean Plankton and Fish During the First Decade of a Subalpine, Man-Made Reservoir.	UNIVERSIDAD NACIONAL DE LA PLATA (ARGENTINA). INST. DE LIMNOLOGIA.
benzenes (LABs): Isomeric Composition of C12 LABs as an Indicator of the Degree of LAB Degradation in the Aquatic Environment.	W90-06599 2H	Primary Production of Phytoplankton of Chas- comus Pond. (Prov. BS.As., Argentina). Critical
W90-07365 5B	TSITSIKAMMA COASTAL NATIONAL PARK, P.O. STORMS RIVER 6308, SOUTH AFRICA.	Evaluation of Photosynthesis Values Obtained by O2 and 14C Methods, (Produccion Primaria
TOKYO UNIV. (JAPAN).	Sea Temperature Variations in the Tsitsikamma	del Fitoplancton de la Laguana de Chascomus (Prov. de Buenos Aires, Argentina). Evaluacion
Conversion of the Digital Land Information Files for the Purpose of Drawing River Bed	Coastal National Park, South Africa, With Notes on the Effect of Cold Conditions on Some Fish	Critica de los Valores de Fotosintesis Obtenidos
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W90-06604

2H

Populations. W90-07245

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UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). ENVIRONMENTAL TOXICOLOGY

UNIVERSIDAD POLITECNICA DE CANARIAS, LAS PALMAS DE GRAN CANARIA (SPAIN). ESCUELA TECNICA SUPERIOR DE INGENIEROS INDUSTRIALES DE LAS PALMAS. Graphic Evolution of the 24,000 Hours (3	UNIVERSITY COLL., CARDIFF (WALES). DEPT. OF APPLIED BIOLOGY. Modelling Ecological Impacts of the Acidifica- tion of Welsh Streams: Temporal Changes In the Occurrence of Macroflora and Macroinverte- brates.	UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND), DEPT. OF APPLIED PHYSICS. Low-cost, Portable Flow Cytometer Specifically Designed for Phytoplankton Analysis. W90-06676 7B
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UNIVERSIDADE FEDERAL DE ALAGOAS, MACEIO (BRAZIL). Toxicity Test with Fishes (Teste de Toxicidade com Peixes Mantidos em Gaiola Flutuante).	Streams for Dippers Cinclus cinclus as a Result of Acidification and Recovery: A Modelling Study. W90-07194 5C	Characterization and Treatment of By-Product Waters from Selected Oil Shale Retorting Tests. W90-06956 5D
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UNIVERSIDADE FEDERAL DO MARANHAO, SAO LUIS (BRAZIL). LAB. DE	UNIVERSITY OF EAST ANGLIA, NORWICH (ENGLAND). SCHOOL OF	W90-06795 5A
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Heavy Metal Contents of Paddy Fields of Al- cacer do Sal, Portugal. W90-07342 5B	ARMIDALE (AUSTRALIA). DEPT. OF RESOURCE ENGINEERING. Limnology of the Dumaresq Reservoir: A Small	Response of Nesting Waterfowl to Flooding In Great Salt Lake Wetlands. W90-07142 6G
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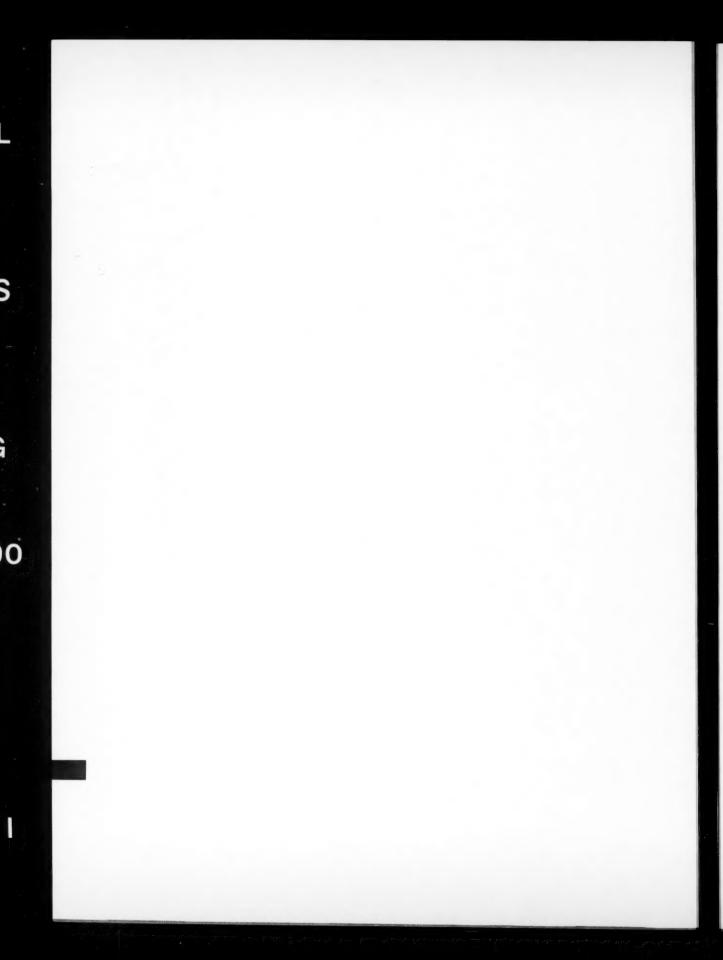
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RESOURCES ENGINEERING.	VYZKUMNY USTAV VODOHOSPODARSKY, PRAGUE (CZECHOSLOVAKIA).	Sediments in Sewers.
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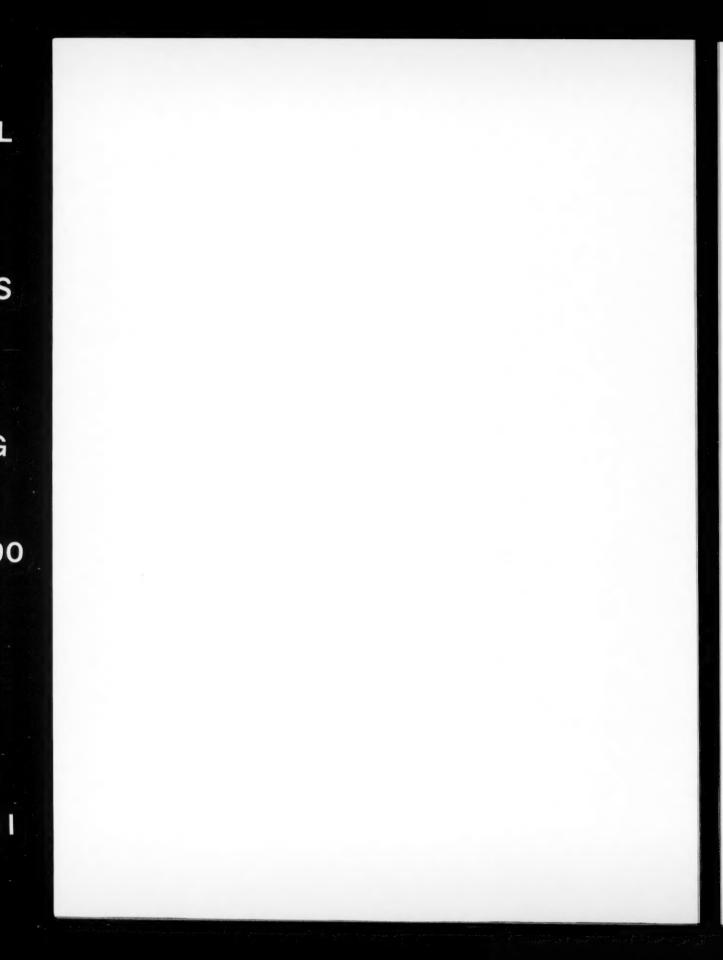
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W90-07278	5A	W90-07349	3E	W90-07420	2K	W90-07489	
W90-07279	5A	W90-07350	5G	W90-07421	5D	W90-07490	2B
W90-07280	5A	W90-07351	5B	W90-07422	5D	W90-07491	
W90-07281	5C	W90-07352	5B	W90-07423	5D	W90-07492	4C
W90-07282	5B	W90-07353	5B	W90-07424	7B	W90-07493	
W90-07283	5E	W90-07354		W90-07425	2H	W90-07494	5G
W90-07284	5B	W90-07355	2F	W90-07426	5F	W90-07495	
				W90-07427	5F	W90-07496	6G
W90-07285	5A	W90-07356					
W90-07286	5A	W90-07357	2G	W90-07428	5D	W90-07497	6G
						W90-07498	5G
W90-07287	5C	W90-07358		W90-07429	5G		
W90-07288	5A	W90-07359	5B	W90-07430	5D	W90-07499	5E
				W90-07431		W90-07500	
W90-07289	5A	W90-07360			3A		
W90-07290	5A	W90-07361	2F	W90-07432	3C	W90-07501	6G
						W90-07502	5B
W90-07291		W90-07362		W90-07433			
W90-07292	5A	W90-07363	2F	W90-07434	3A	W90-07503	5B
						W90-07504	
W90-07293		W90-07364		W90-07435			
W90-07294	5A	W90-07365	5B	W90-07436	3A	W90-07505	5C
						W90-07506	
W90-07295	5A	W90-07366	38	W90-07437	3A	W 50-07300	30





Subject Fields

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- WATER SUPPLY AUGMENTATION 3 AND CONSERVATION
- WATER QUANTITY MANAGEMENT 4 AND CONTROL
- WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
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- SCIENTIFIC AND TECHNICAL 10 INFORMATION

1990 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360-4.

Microfiche & Paper Copy Reports

		Proc	

Standard Prices	Exception Prices	Diskettes	Magnetic Tapes
A01\$8.00	E01\$10.00	D01\$50	T01\$165
A02 11.00	E02 12.00	D02 80	T02220
A03 15.00	E03 14.00	D03 130	T03340
A04-A05 17.00	E04 16.50	D04 180	T04 450
A06-A09 23.00	E05 18.50	D05 230	T05 560
A10-A13 31.00	E06 21.50	D06280	T06 670
A14-A17 39.00	E07 24.00	D07330	T07780
A18-A21 45.00	E0827.00	D08380	T08890
A22-A25 53.00	E0929.50	D09430	T091,000
A99	E10 32.50	D10480	T101,110
	E1135.00	D11530	T111,220
MAIN ()/	E1238.50	D12580	T121,330
"N" Codes	E1341.00	D13630	T131,440
N01\$60.00	E14 45.00	D14680	T14 1,550
N02 59.00	E1548.50	D15730	T151,660
N03 20.00	E1653.00	D16780	T161,770
	E17 57.50	D17 830	T17 1,880
	E1862.00	D18880	T181,990
	E19 69.00	D19930	T192,100
	E20 80.00 E99	D99*	T99*

* Contact NTIS for price

Prices effective January 1, 1990

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